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Public Goods, Interregional Transfers and Constitutional Choice in a Regional Model With Majority Voting

by

© Tracy R. Snoddon

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Department of Economics

Edmonton, Alberta

Spring 1995

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **Public Goods, Interregional Transfers and Constitutional Choice in a Regional Model With Majority Voting** submitted by **Tracy R. Snoddon** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy.**

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21 April 1995

Dedication

This dissertation is dedicated in memory of my father, David A. Snoddon.

Abstract

The basic model focuses on the effects of majority voting on public goods provision and the allocation of mobile labour under alternative assumptions regarding individual and regional government myopia. Myopic and non-myopic public goods provision rules are derived and compared to the social optimum. The model is then extended to consider the incentives of regional minorities to transfer income to the majority to purchase a more preferred fiscal package. Regional majorities' incentives to make voluntary transfers to non-residents are also explored and compared to the interregional transfers made in alternative fiscal externality environments. Production uncertainty is introduced into the model to investigate a social insurance rationale for interregional transfers. A constitutional choice framework permits an investigation of the incentives of regional majorities to agree to interregional transfers before the uncertainty is resolved. A unique feature of this model is the endogenous determination of a federal government structure.

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I would like to acknowledge Drs. Bev Dahlby and Stuart Landon for their guidance and support during my years at the University of Alberta. I would also like to recognize the support and encouragement of my mother, Elizabeth Snoddon, who is both a friend and mentor.

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Table of Contents

		Page
Chapter I:	**Introduction**	1
Chapter II:	**Review of the Literature**	13
II.1..........	The Fiscal Externality Literature	16
II.2..........	The Majority Voting Literature	52
II.3..........	The Optimal Design of a Constitution	66
II.4..........	Conclusions	81
Chapter III:	**Regional Model With Majority Voting and Diverse Preferences**	83
III.1.........	Two Region Framework	86
III.2.........	Regional Public Goods Provision With Immobile Individuals	92
III.3.........	Public Goods Provision With Mobile Type A Individuals	100
III.4.........	Migration Equilibrium and Majority Voting	113
III.5.........	A Numerical Example	124
III.6.........	Conclusions	129
Chapter IV:	**Majority Voting and Transfers**	132
IV.1.........	Incentives for Intraregional Transfers and Majority Voting	138
IV.2.........	Incentives for Interregional Transfers	152
IV.3.........	Migration Equilibrium and the Incentives for Interregional Transfers	160
IV.4.........	Conclusions	177
Chapter V:	**Majority Voting, Uncertainty and Constitutional Choice**	
V.1..........	Production Uncertainty and Risk Averse Individuals	183
V.2..........	Migration Equilibrium Under Alternative Constitutions	193
V.2.1.......	Migration Equilibrium Without A Constitution (No Insurance)	205
V.2.2.......	Migration Equilibrium With A Constitution (With Insurance)	207
V.3.........	Characterization of Equilibria Under Alternative Constitutions	208
V.4.........	Constitutional Choice Under Uncertainty	219
V.5.........	Constitutional Choice: Computed Examples	223
V.6.........	Sensitivity Analysis	238
V.7.........	Conclusions	242
Chapter VI:	**Conclusions**	246
Bibliography		255
Appendix A		260
Appendix B		263
Appendix C		271

List of Tables

Page

Table III.1: Parameter Values 125

Table III.2: Myopic and Non-myopic Equilibrium Solutions When Type B Majorities Exist in both Regions 126

Table V.1: Summary of Constitutions and Federal Government Instruments 204

Table V.2a: Production and Utility Parameters 224

Table V.2b: Population Parameter Values 224

Table V.3: Summary of Constitutional Choices By Population Configurations and Available Information 226

Table V.4: Constitutional Rankings: Type A Majorities Exist in Both Regions and Voluntary Transfers Not Permitted Under the Constitution 232

Table V.5: Constitutional Rankings: Type A Majorities Exist in Both Regions and Voluntary Transfers Permitted Under the Constitution 233

Table V.6: Constitutional Rankings: Type B Majorities Exist in Both Regions and Voluntary Transfers Not Permitted/ Permitted Under the Constitution 234

Table V.7: Constitutional Rankings: Type A Majority in Region 1 and Type B Majority in Region 2 and Voluntary Transfers Not Permitted/ Permitted Under the Constitution 235

Table V.8: Summary of Constitutional Choices by Available Information for Different Values of the Production Shock (θ_H and θ_L) 239

Table V.9: Summary of Constitutional Choices by Available Information for Different Values of Region 1's Land Endowment (T_1) 239

Table V.10: Summary of Constitutional Choices by Available Information for Different Values of Region 1's Endowment of Immobile Labour (L_1^B) 240

Table V.11: Summary of Constitutional Choices by Available Information for Different Values of the Utility Parameter (ρ) 240

List of Figures

Page

Figure II.1 58

Figure II.2 74

Figure III.1 96

Figure III.2 97

Figure III.3 99

Figure III.4 121

Figure IV.1 139

Figure V.1 189

Figure V.2 210

Figure V.3 211

Figure V.4 217

Figure V.5 218

Chapter I. Introduction

A common feature of many federal systems like Canada, the United States and Australia is the existence of interregional or intergovernmental transfers. Participation in a federation and the magnitude and direction of these interregional transfers are determined by historical, political, constitutional and economic forces. The most commonly espoused theoretical rationale for such transfers is the efficiency hypothesis as developed in the fiscal externality literature. Finding its roots in Tiebout (1956), this particular literature has grown from early research undertaken in Buchanan and Goetz (1972), Flatters, Henderson and Mieszkowski (1974), Boadway and Flatters (1982), and, more recently, by Myers (1990), Burbidge and Myers (1994) and others. The essence of the efficiency argument is that decentralized decision-making at regional levels leads to fiscal differences across regions. Mobile individuals may move in response to these fiscal differences rather than move to the region where their marginal social contribution is highest. While, under some circumstances, regional governments may make interregional transfers voluntarily, these transfers do not generally achieve an optimal allocation of population across regions. Consequently, centrally-coerced interregional transfers are required to achieve a socially optimal regional distribution of labour

Popular belief is that equalization or interregional transfers in federal systems are, however, empirically motivated by equity or insurance principles rather than efficiency considerations. Boadway and Hobson (1993), for example, argue that when fiscal responsibilities are allocated to lower levels of government, fiscal inequities can arise where similar individuals are treated differently by different regional fiscal systems. Differences in resources, populations, tax rates, or local preferences for redistribution, for example, can all lead to differences in regional fiscal environments and fiscal inequities. Using this argument, interregional transfers can be motivated on the basis of fiscal inequities or a horizontal equity principle.

Equalization based on equity considerations is also consistent with the principle of social insurance. Boadway (1992) discusses the notion of social insurance as publicly provided insurance against being "unlucky at birth". Since private insurance must be purchased before the insured event occurs, private insurance is not available. Boadway argues that this market failure in the private insurance market provides a rationale for the government to provide social insurance after the fact. In section 36(2) of Canada's *Constitution Act 1982*, the federal government is committed to the principle of equalization such that provinces are able to provide reasonably comparable levels of public services at reasonably comparable tax rates. This principle of equalization is consistent with both the notion of social insurance and fiscal or horizontal equity. Canada's constitutional commitment to interregional transfers or equalization suggests an examination of interregional transfers from a constitutional perspective as a potentially fruitful avenue to explore.

Despite popular belief and empirical evidence, neither the equity nor the social insurance rationale receives much formal treatment in the economics literature. This thesis is motivated in part by this gap between the theory and practice of interregional transfers. Additional motivation for this research stems from the criticism that much of the fiscal externality literature overlooks important characteristics of federal systems. A reality of many federal systems is the presence of different orders of government each with its own powers and responsibilities. Intergovernmental negotiation is also another important characteristic of many federal systems. Few of these features are, however, captured in fiscal externality models. In addition, regions are often assumed to be homogenous in this literature, but, in reality, diversity within regions plays an important role in regional government decision-making. Regional homogeneity is a strong assumption and furthers limits the usefulness of these models.

While the fiscal externality literature demonstrates that some form of interregional transfer is necessary to ensure an optimal regional distribution of population, the conclusion often drawn is that an external or federal authority is necessary to make the required interregional transfers. This literature does not, however, explore how such a federal authority may arise or under what conditions the efficiency transfers would or could be made by a federal authority. In particular, regional government participation in a federal system that imposes centrally-coerced transfers is left unexplained.

This thesis argues that the forces leading to the development of a federal structure are also likely to be important determinants of the limitations and responsibilities of the federal authority and of the purpose and structure of any centrally-imposed interregional transfers. In addition, the concentration of the fiscal externality literature on the efficiency rationale for equalization and the assumption of regional homogeneity limit the usefulness of these models in explaining regional government behaviour and interregional transfers in federal systems where transfers are driven by equity or insurance considerations.

To address these concerns, this thesis begins with a review of the fiscal externality, the majority voting, and the optimal design literatures, presented in chapter II. The evolution and important contributions of each of these literatures are detailed and, in particular, attention is drawn to the gaps and omissions briefly discussed above. Section II.1 focuses on the development of the fiscal externality literature since the structure of the model developed in this thesis closely resembles the structure of models often found in this literature. While models of majority voting are quite different in structure and purpose to the model developed here, it is also useful to briefly review the characteristics of these models since the majority voting mechanism is adopted here. This review is provided in section II.2 of chapter II. Chapter II concludes with a review of recent developments in the optimal design literature and a summary of the contributions of this thesis to each of these literatures.

In chapter III, the thesis develops a regional model of public goods provision that incorporates diversity within regions. A collective choice rule is required for reconciling this intraregional diversity and for determining regional government decisions. A simple majority voting rule is introduced into the fiscal externality model developed in this chapter. Using this model, the effects of majority voting on local public goods provision, the migration equilibrium, and the social optimum are examined for alternative assumptions regarding individual and regional government behaviour, thus extending the fiscal externality literature.

In chapter IV, the thesis contributes to more recent developments in the literature by extending the model to consider the incentives to make voluntary income transfers both within and outside the region in a fiscal externality model with intraregional diversity and majority voting. The chapter begins with an examination of regional minorities' incentives to make transfers to individuals in the majority in order to influence the majority's fiscal choices. Following this, regional majorities' incentives to make voluntary interregional transfers are derived and compared with the voluntary transfers called for elsewhere in the literature.

Rather than presume the exogenous existence of a federal or central government, the thesis examines how such a federal structure might emerge endogenously within a fiscal externality model. To investigate an insurance rationale for interregional transfers, production uncertainty is introduced into the model in chapter V. The thesis then examines whether an interregional transfer scheme, specifying the role and responsibility of a federal authority, would be adopted if regional governments choose the "constitution" before the state of the world is known. In particular, regional majorities' incentives to adopt an interregional transfer scheme as a form of insurance are explored under alternative assumptions regarding the availability of information at the time of constitutional negotiations and for alternative population configurations. Several equilibria are computed numerically to investigate the welfare implications of the model and to illustrate the choice of constitution under alternative assumptions regarding the identities of regional majorities, the participants to the constitutional negotiations, and the type of information regional majorities possess at the time when constitutional decisions must be made.

By adopting this constitutional choice framework, the model is able to examine whether a federal authority would arise endogenously in the model and what form of federal government is most likely to be adopted. In addition, the model permits an investigation of the purpose and structure of interregional transfers that are chosen as part of a constitutional design. Given risk averse individuals and regional governments, the adoption of federally-administered interregional transfers captures the social insurance rationale for equalization in a federal system like Canada.

In addition to these extensions and contributions to the fiscal externality literature, this thesis contributes to the majority voting and optimal constitutional design literatures. While the majority voting literature examines local public goods provision in a framework with intraregional diversity, individual mobility and majority voting, income is assumed to be exogenous and, therefore, location-independent. The model developed in chapters III and IV also examines regional public goods provision given majority voting, intraregional diversity and mobile individuals but where individual income is endogenous. With the introduction of uncertainty and a constitutional choice framework in chapter V, this research provides a link to the literature on the optimal design of constitutions. In particular, the most recent developments in this literature examine the effects of risk aversion and uncertainty on constitutional design in models without public goods and intraregional diversity. The model in chapter V extends these models by examining the effects of uncertainty and risk aversion on constitutional design in a model that permits intraregional diversity, migration and local public goods.

Having outlined how this research extends and contributes to each of the relevant literatures, the major results of the thesis can be summarized. The model in chapter III demonstrates the properties of a fiscal externality model when intraregional diversity and majority voting are introduced. In contrast to much of the fiscal externality literature, public goods are seldom provided optimally according to the traditional Samuelson rule when regional fiscal decisions are determined by majority voting. In general, majority voting implies that the preferences of the minority individuals in the region are not satisfied with the majority's fiscal choice. Assumptions regarding individual and regional government myopia with respect to the migration effects of their fiscal decisions are shown to matter to public goods provision and the migration equilibrium when regional fiscal decisions are governed by a majority voting rule and financed by a uniform head tax. This contrasts with much of the fiscal externality literature where myopia assumptions leave public goods provision and the migration equilibrium unchanged when uniform head taxes are used to finance public expenditures. This result demonstrates that the introduction of majority voting in a fiscal externality model increases the importance of behaviourial and modelling assumptions for the conclusions regarding the optimality of public goods provision and the distribution of labour and for the predictions regarding the necessary corrective or efficiency-enhancing transfers.

Chapter IV considers regional incentives to make transfers within a region and across regions. The model demonstrates that, in the absence of free riding and labour mobility, a regional minority has an incentive to voluntarily transfer income to individuals in the majority only if the minority individuals' income exceeds the income of individual in the majority. Once labour mobility is introduced, this condition on relative incomes is no longer necessary to ensure that regional minorities make positive transfers to individuals in the majority. In part, these results indicate that minority transfers provide a means of circumventing the uniform taxation constraint imposed in the model to finance public goods. The model also demonstrates that, under certain conditions, regional majorities have incentives to voluntarily transfer income across regions. Positive interregional transfers in this context offer regional majorities more effective control over immigration into the region.

In some instances, the fiscal externality literature demonstrates that voluntary transfers are sufficient to restore the optimal distribution of mobile labour, thus eliminating the need for centrally-coerced transfers. Once intraregional diversity and majority voting are introduced, however, this thesis shows that voluntary transfers between regions are no longer sufficient to achieve the optimal distribution of labour. Unless all individuals within a region have identical incomes, majority voting fails to achieve either the optimal level of public goods provision or the optimal distribution of mobile population. Hence, centrally-coerced transfers are required in this model to achieve the social optimal.

The analysis in chapter V shows that uncertainty creates incentives to adopt a constitution, or interregional transfer scheme, as a form of insurance and that the type of insurance adopted depends on the identity of the regional majorities as well as the availability of information at the time of constitutional decision-making. Of the representative constitutions contemplated, neither a constitution that commits the federal government to interregional transfers that maximize private output nor a constitution that achieves the socially optimal distribution of labour are adopted for any of the numerical examples considered. The most often adopted constitution is one which commits the federal government to ensuring that, regardless of individual characteristics, individuals have identical incomes before regional taxes and transfers. In other words, regional majorities most often choose to unanimously adopt a constitution that insures individuals for utility variations by individual characteristics after the state of world is known. Only for the case where the identities of regional majorities differ across regions is a different constitution adopted. In this case, a constitution which offers less insurance and less income redistribution is preferred under certain conditions. These results appear to be fairly robust with respect to changes in the availability of information available at the time of constitutional negotiations and to small changes in the model's parameter values.

In addition to these contributions to the theoretical literature on interregional transfers and majority voting, the thesis draws attention to some important policy considerations. The results of chapter IV demonstrate that voluntary interregional transfers between persons are not equivalent to interregional transfers between governments. For example, if transfers are made to regional majorities then a transfer is accepted by a region only if it improves the welfare of individuals in the majority. If, on the other hand, transfers are made directly to individuals, then the majority of a region that receives such transfers can be made worse off. Voluntary transfers between regional governments tend to benefit those individuals whose interests are closely aligned with the interests of government. This result has important policy implications for transfers made by the federal government. Depending on the purpose of federally-administered interregional transfers, whether these transfers are made to individuals or to governments determines how effective these transfers are in achieving their goal. While the model in chapter V assumes that federal transfers are made to persons and not to governments, the analysis raises the issues of whether voluntary transfers should be permitted by the constitution and whether interregional transfers are made to persons or to governments.

In light of the current political climate in Canada, this research suggests some interesting predictions regarding interregional transfers and potential changes to these transfers in the face of renewed constitutional negotiations. For example, what possible changes to the principle and form of equalization might result after the Quebec referendum? Currently, equalization in Canada takes the form of interregional transfers that equalize tax capacity, including partial equalization of resource rents. The results of the model developed in chapter V are consistent with this type of equalization if we view constitutional negotiations to be between Quebec and the rest of Canada and if we assume that the regional majorities in Quebec and in the rest of Canada are comprised of relatively immobile and mobile individuals respectively. The results from chapter V indicate that if the identities of regional majorities differ (some are mobile and others are immobile) then regional majorities are more likely to adopt a rent sharing constitution.

Suppose Quebec opts for economic association and is, as a result, no longer entitled to equalization under the constitution. This may prompt a renegotiation of the constitution and as well as the principle of equalization. If the remaining provincial governments are considered similar then this thesis predicts a renegotiation of equalization may result in a move toward greater income sharing or equalization that provides more rather than less income redistribution through federally-administered interregional transfers. If, on the other hand, the identities of the remaining provincial majorities are assumed to differ, the status quo may prevail. For example, the rest of Canada consists of the western provinces, Ontario and the Atlantic region. If individuals in the Atlantic region are considered relatively immobile while the rest of Canada is considered mobile, then the analysis in chapter V suggests that constitutions with extensive income sharing are not likely to be adopted. Thus, the status quo equalization may continue.

Sovereignty association for Quebec may increase uncertainty in the Canadian economy and will certainly change the migration equilibrium for the country. Will this increase in uncertainty be temporary and therefore leave the constitution intact or will the changes in population distribution, mobility and uncertainty be large enough to necessitate a renegotiation of the Canadian federation and the constitution? If so, what will the new constitution look like and how might the constitution evolve over time? The model developed in this thesis provides a framework within which some of these questions can potentially be explored. This model can be extended to consider interregional transfers and constitutional choice in a dynamic framework. This refinement would allow an examination of how constitutional choices and the evolution of constitutions depend on history. For example, such a model could investigate how the identities of the original participants to the constitution affects the initial choice of constitution and how the constitution changes in response to shocks over time.

Chapter II Review of the Literature

The motivation for this research stems from a dissatisfaction with the efficiency rationale for equalization as developed in the fiscal externality literature. Two important realities are overlooked in this literature. Regions are often assumed to be homogenous but, in reality, diversity within regions plays an important role in regional government decision-making. In fiscal externality models, where the analysis focuses on regional rather than local or community decision-making, the assumption of regional homogeneity is a strong one and limits the usefulness of these models. To address this concern, the model developed in this thesis introduces intraregional diversity and adopts a majority voting mechanism to resolve differences in opinions regarding government fiscal decisions. Regional public goods provision in a migration equilibrium are then examined under alternative assumptions regarding individual behaviour and regional fiscal instruments.

The second reality of federal systems, like those in Canada, the U.S. and Australia, is the presence of different orders of government each with its own powers and responsibilities. Participation in the federation and relationships between orders of government are determined by historical, constitutional, political and economic forces. In addition, intergovernmental negotiation is an important characteristic of many of these systems. Few of these features are captured in fiscal externality models where the existence of a central authority with the appropriate powers to achieve efficiency is often presumed. Regional participation in centrally-coerced interregional transfers and the rationale for decentralized decision-making in this context are left unexplained. Both factors are likely to be important determinants of the nature and design of any interregional equalization in a federal system. In this dissertation, regional government participation in interregional transfers is modelled as a constitutional choice problem where the future is uncertain and constitutional choices are made before regional fiscal decisions on public goods provision. Regional participation is a key determinant of the "federal system" that emerges within the model in this context. Uncertainty is introduced into the model with intraregional diversity and majority voting to formally consider this problem.

In addressing the concerns outlined above, this thesis touches on three related literatures, the fiscal externality literature, majority voting models, and the literature on the optimal design of constitutions. Both the fiscal externality and majority voting literatures focus attention on local or regional public goods provision when individuals are mobile between jurisdictions. The number of jurisdictions is exogenous and regional governments are free to choose the local fiscal package. Fiscal externality models examine the efficiency properties of the migration equilibrium and determine the corrective transfers necessary to restore efficiency. In fiscal externality models diverse intraregional preferences are not often considered. In contrast, majority voting models focus on intracommunity fiscal decisions given a specific mechanism for reconciling diverse preferences within a region. These models examine the existence and stability properties of migration equilibria and compare public goods provision with majority voting to the social optimum. In addition, the ability of regional or local governments to pursue redistribution in a local setting with decentralized public decision-making is studied to address the question of what level of government should be assigned the redistributive function. Models in both the fiscal externality and majority voting literatures often presume the existence of a federal structure or a central government.

In contrast, the optimal design of constitutions literature attempts to explain government structures and the division of government powers and responsibilities among different levels of government. In these models, assignment of expenditure responsibilities, allocation of tax fields and interregional transfers are endogenously determined. By adopting a constitutional framework, this literature reflects the empirical observation that assignment and allocation within a particular setting are the outcome of some negotiations process. This literature also considers the role of economic efficiency and equity in determining the optimal assignment of functions and the influence of risk aversion and uncertainty on constitutional design.

This chapter begins with a discussion of the fiscal externality literature which provides only one of several rationales for equalization or interregional transfers. Since the structure of the model developed in chapters III, IV, and V closely resembles the fiscal externality models, the review presented in section II.1 focuses on the development of this literature. While models of majority voting are quite different in structure to the model developed here, it may be useful to briefly review the characteristics of these models for purposes of comparison since this thesis adopts the majority voting mechanism for regional decision-making. This review is provided in section II.2 of this chapter. A brief review of the literature on the optimal design of constitutions and how the model developed here relates to this literature is presented in section II.3. Section II.4 summarizes the contribution of this dissertation to these literatures.

II.1. The Fiscal Externality Literature

In the broad literature on fiscal federalism, several rationales have been proposed for interregional transfers in a federal system. In the political and public policy arena, the motivations for interregional transfers centre around vertical and horizontal imbalances.[1] A vertical fiscal imbalance refers to the potential for a mismatch between revenue sources and expenditure responsibilities at a given level of government. The distribution of taxing and spending powers within the federal hierarchy are assumed to be determined by constitutional, historical, political and economic forces. Since many factors influence this distribution, there are no guarantees that all orders of governments possess adequate revenue potential to meet expenditure responsibilities. Transfers between levels of government can then be used to ensure sufficient funds are available.

Horizontal fiscal imbalance describes a situation where revenue potential and expenditure demands differ across governments at the same level within the federal structure. Transfers from one government to another are used to eliminate or reduce these differences and have been motivated by both efficiency and equity considerations. Fiscal externality models generally contain some horizontal fiscal imbalance that leads to inefficiencies. In such models, interregional transfers are often required to restore the optimal distribution of population. While other rationales for interregional transfers have been explored in the literature on fiscal federalism, the efficiency rationale has by far received the most attention.[2] For this reason, this literature review focuses on horizontal fiscal imbalance and the fiscal externality literature.

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[1] For a general description of these concepts in the Canadian context, see Courchene (1984) and Boadway and Hobson (1993). A theory of vertical fiscal imbalance using a three sector model is developed in Hettich and Winer (1986). More recently, Ruggeri, Van Wart, Robertson and Howard (1993) discuss the impact of recent federal initiatives such as the partial de-indexation of the personal income tax, the clawback of some transfer programs, and federal government offloading on Canada's vertical fiscal imbalance and how a reallocation of tax fields could restore the fiscal balance.

Origins of the Fiscal Externality Literature: The Inefficiency Result

Regional models with equalization or interregional transfers developed from a literature designed to examine more closely the efficiency of fiscal decentralization and the assumptions of the Tiebout model. One of the first formal economic models to demonstrate the potential efficiency gains from a decentralized public sector, the model developed in Tiebout (1956) simultaneously solves the preference revelation problem discussed by Samuelson (1954) and ensures an optimal allocation of individuals over jurisdictions. The central result of this model is that perfectly mobile individuals reside in communities that provide their preferred mix of public goods.

---

[2] Dahlby and Wilson (1994) provide an alternative rationale for equalization based on minimizing the social costs associated with financing regional public expenditures using distortionary taxes. In contrast to the mainstream fiscal externality literature, Dahlby and Wilson assume individuals are immobile. A horizontal equity rationale for equalization is developed in Hartwick (1980) and Boadway and Hobson (1993).

Several restrictive assumptions are necessary for these Tiebout results to hold. Income must be independent of an individual's location, only fiscal criteria are relevant in individuals' decision-making and a sufficiently large number of jurisdictions relative to individual types is required. In addition, regions provide pure local public goods and there are no economies of scale in production, no spillovers and no externalities. With these assumptions, community-based head taxes levied to finance the public good are equivalent to benefit taxes and are non-distortionary.

Building on the earlier work of Buchanan and Wagner (1970), Buchanan and Goetz (1972) assess the efficiency merits of the Tiebout model. Their discussion takes issue with the restrictive assumption of location-independent income and the lack of any real spatial dimension in the model. The failure to incorporate a spatial dimension implies that an individual's choice of community leaves private production unaffected. To address this issue, Buchanan and Goetz allow the marginal private product of labour to be regionally differentiated or endogenous. When income is endogenous and regional fiscal decision-making is decentralized, Buchanan and Goetz show that the migration equilibrium is not optimal.

Although the paper lacks a formal modelling structure, the authors derive the necessary conditions for a Pareto optimal allocation of individuals across communities and compare these to the conditions that prevail in a free migration equilibrium. With the introduction of public goods, Pareto optimality requires that the total value of output, both private and public, be maximized. This condition is formalized in equation (II.1) below:

$$F_i^h + MVG_i^h = F_j^h + MVG_j^h \qquad \text{(II.1)}$$

where individuals are indexed by h and locations by i and j.[3] F_i^h and MVG_i^h refer respectively to the marginal private product and the marginal public product generated by individual h in region i. The marginal public product consists of the net benefits accruing to individual h from the public good (the total benefit to individual h minus the tax payment) and the migration externality effects discussed below.

With local provision and financing of public goods, individuals' migration decisions can generate migration externalities. For example, a given level of a pure public good in region i can be financed with a lower per person head tax when an additional individual moves to this region. Since individuals' private decisions do not incorporate the effects of their location choice on the tax price faced by residents in that locality and by those who reside elsewhere, a tax externality is created.[4] Buchanan and Goetz also refer to two possible benefit externalities created by the migration decision. If the public good is impure and subject to congestion, then migration of an additional individual to region i increases (decreases) the congestion in the destination (origin) community. The authors define fiscal surplus as the benefits received from the public good minus the individual's tax share. A second type of benefit externality is created when the fiscal surplus of the migrant and of all other individuals changes with migration-induced changes in the equilibrium level of public good provided in each community.

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[3] Where possible, the notation used in the models reviewed is modified to ensure consistency with the notation developed in subsequent chapters of this thesis. The reader is referred to the source of each model for the original notation.

[4] The tax price externality is also referred to as a fiscal or cost-sharing externality.

Pareto optimality requires that the marginal net social benefit of a type h individual be equated across all possible location choices for all types of individuals. Since private migration decisions fail, however, to include the tax and benefit externalities, the equilibrium distribution of labour differs from the Pareto optimal distribution. This is the fiscal externality inefficiency result. While the authors present few generalized results, some examples are provided to illustrate how a free migration equilibrium, like that envisioned by Tiebout, generally leads to a suboptimal population distribution.

Subsequent developments in the literature tend to focus on one of three different themes, corrective transfers, the appropriate set of regional fiscal instruments, and non-myopic government behaviour, although there is a significant amount of overlap in each of these areas. In general, the recent contributions adopt more rigorous modelling structures and, by imposing simplifying assumptions, are able to obtain more substantive results than those obtained in Buchanan and Goetz.

The Fiscal Externality and Corrective Transfers

A formal modelling structure based on the Buchanan and Goetz (1972) framework is developed in Flatters, Henderson and Mieszkowski (1974), herein FHM. FHM derive the condition for an optimal population distribution and show that, in general, an interregional transfer of income is required to achieve the optimum as a migration equilibrium. The FHM model consists of two regions with identical Ricardian production technology and different endowments of land. Output in region i can be allocated to either a private consumption good, x_i^h, or a pure local public good, G_i. The population is homogeneous and perfectly mobile and each individual's labour endowment is inelasticly supplied.[5] The superscript, h, is the same for all individuals and could be dropped.

The socially optimal allocation of population is derived from the planner's problem: to maximize the utility of a representative resident in one region subject to an equal utility constraint, regional production feasibility constraints, and the ability of the central planner to make interregional transfers via taxes and subsidies. The first order condition to this problem requires that the marginal net social benefit of population be equal across regions (i.e. the value of total output, both private and public, is maximized). This condition is equivalent to the optimality condition, equation (II.1), derived in Buchanan and Goetz (1972).

The marginal net social contribution of an additional individual consists of the individual's marginal product minus the individual's private good consumption, or $F_i^h - x_i^h$. Since the public good is pure, an individual's social contribution is not reduced by the consumption of the public good. Using this notation, the optimal condition for the allocation of labour can be written as

$$F_1^h - x_1^h = F_2^h - x_2^h \quad . \tag{II.2}$$

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[5] These models are concerned with the optimal allocation of population or labour across regions. Often the two are used interchangeably. An individual's labour endowment is normalized to one so that labour and population are equivalent.

An individual's consumption of the private good, x_i^h, is equal to an individual's marginal product minus taxes paid or $F_i^h - \tau_i$. Substituting out for private goods consumption, equation (II.2) implies that the socially optimal population distribution requires:

$$\tau_1 = \tau_2 \quad ,$$

or that per person taxes, τ_i, are equal across regions.

With decentralized public decision-making, regional governments choose the level of the public good to maximize per capita utility, financing these expenditures with a residency-based tax, τ_i. The resulting migration equilibrium is characterized by equal per capita utility across regions and, in general, a lower marginal product of labour, a lower land to labour ratio and a lower tax price for the public good in the region with the greater endowment of land. In general, the FHM two region model implies that the well-endowed region is over (under) populated in a free migration equilibrium.[6]

FHM calculate the interregional transfer necessary to support a Pareto optimal allocation of population for the case where the compensated elasticity of demand for the public good is inelastic and region 1 is more well-endowed with land. In this example, region 1 must pay a positive transfer to region 2 to achieve the optimal distribution of population. In FHM, the per person subsidy paid to the residents of region 2 from the residents of region 1 is denoted as V and L_1 , L_2, τ_1 and τ_2 represent regional populations and income tax rates respectively. Assuming that transfers from the central government are taxable by regional authorities, V is chosen to ensure that net taxes are equalized across regions:

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[6] Only if the compensated price elasticity of demand for the public good is equal to minus one does the free migration equilibrium yield a Pareto optimal population distribution. With a unit elastic demand curve, each region's per capita tax is constant and identical across regions. Thus, only in this case, in the free migration equilibrium when individuals migrate to maximize utility, are per capita taxes equal and the distribution of population optimal.

$$\text{(II.3)} \qquad \tau_2 F_2^h - (1-\tau_2)\frac{VL_1}{L_2} = \tau_1 F_1^h + (1-\tau_1)V \ .$$

The lefthand side of the above expression represents the net taxes paid by an individual in region 2 and consists of wage taxes, $\tau_2 F_2^h$, minus the net-of-tax subsidy from region 1, $(1-\tau_2)(L_1 V/L_2)$. In region 1, total taxes paid by an individual consist of wage taxes, $\tau_1 F_1^h$, plus the per person tax, V, for the interregional subsidy minus $\tau_1 V$ (a tax rebate). Rearranging equation (II.3), the following expression can be obtained for the optimal interregional transfer:

$$\text{(II.4)} \qquad V = \left[\frac{L_2}{L_2(1-\tau_1) + L_1(1-\tau_2)}\right](\tau_2 F_2^h - \tau_1 F_1^h) \ .$$

Implicit in this approach is the presumption of a central government with the power to effect these interregional transfers, or, alternatively, that regional governments make the transfers voluntarily. However, until Krelove (1988) and Myers (1990), the issue of voluntary transfers is not formally considered in the literature.[7] Extensions of the model to include impure or congestible public goods or nonconstant returns to scale require some modifications to the optimality condition of equal per person taxes across regions. In the case of congestion, for example, the optimal distribution of the population is achieved when the difference in per person taxes across regions is equal to the difference in regional congestion costs at the margin. Like Buchanan and Goetz, the introduction of additional considerations to the simple model prevent any general conclusions on the direction of the distortion and whether the well-endowed region is likely to be over- or under-populated.

The implications of heterogeneity of preferences are briefly discussed in both Buchanan and Goetz (1972) and FHM. Buchanan and Goetz examine this issue in the context of locational rents defined as the difference in an individual's willingness to pay to reside in a given location and an individual's actual payment. If a sufficiently large number of similar individuals are not available to bid down these rents, rents may persist in a free migration equilibrium. The implication for efficiency is that individually-discriminating taxes and transfers may be required. Information constraints are likely to be severe and the ability to pursue such horizontally inequitable or asymmetric policies is also likely to be severely constrained and costly so as to render the efficient or Pareto optimal allocation unattainable. The discussion in FHM concurs with this conclusion.

In a more generalized setting, Stiglitz (1977) confirms the free migration inefficiency result and demonstrates the necessity of an interregional transfer. In addition, Stiglitz (1977) surveys several problems arising from the free migration equilibria that typically emerge in these models. The existence and stability properties of migration equilibria under alternative hypotheses are compared and the implications of many of the assumptions traditionally found in the literature are analyzed. In particular, Stiglitz focuses attention on public goods provision when regional governments are assumed to be non-myopic in contrast to the more common assumption of myopic governments that take regional populations as fixed. This research lead to the development of a subset of models that examine public goods provision under alternative assumptions of myopia. These models are discussed later in this chapter.

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[7] These papers are discussed later in this section.

The implications of individual heterogeneity and redistributive regional government policy on the migration equilibrium and for corrective transfers are considered in Boadway and Flatters (1982). The contribution of this particular model is its recognition of the distinction between residency-based and source-based taxation and the role of each in determining inefficiencies in the regional allocation of capital and labour.[8] In addition, the Boadway and Flatters model neatly summarizes much of the earlier work in this area.

To begin, the optimal distribution of a federation's resources is considered in the context of a two region model similar to FHM. Regional governments finance public expenditures with revenues raised from head taxes and, in contrast to FHM, all land rents are publicly owned and shared with residents on an equal per capita basis. Boadway and Flatters define the services of the public good as G_i/L_i^{α} to allow for a congestible local public good. The quantity of the public good is given as G_i where α and L_i represent a congestion parameter and the region's population respectively. If α is equal to zero (one) G_i is a pure public (private) good.

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[8] A tax is residency-based if its payment is contingent on the individual residing in the region where the tax is levied. Source-based taxation occurs when taxes are imposed on income at source and is paid by individuals regardless of whether they reside in the region where the tax is levied.

As in previous models, the free mobility of individuals and decentralized decision-making motivate the efficiency rationale for equalization. The authors identify two types of externalities in the free migration equilibrium: a fiscal externality and a rent sharing cost. The fiscal externality is defined as the difference in the tax contribution and congestion costs imposed by the migrant. With pure local public goods, this fiscal externality reflects the fact that an additional resident in region i reduces the revenues required from other residents to finance the public good by the amount of the new resident's tax contribution. This benefit is reduced by an increase in congestion costs imposed by the new resident if G is an impure public good. Since residency confers a rent share, rents accruing to other residents are diminished when an individual migrates into the region. Boadway and Flatters refer to this externality as a rent sharing cost.[9]

As derived from the planner's problem to maximize the utility of individuals in one region subject to the equal utilities condition, the optimal distribution of labour must satisfy the equal per capita taxes condition:

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[9] This rent sharing externality is also present in Stiglitz (1977).

(II.5) $$\left(\frac{(1-\alpha)G_1}{L_1} - \frac{R_1}{L_1}\right) - \left(\frac{(1-\alpha)G_2}{L_2} - \frac{R_2}{L_2}\right) = 0 \quad ,$$

where R_i represents the total rents earned on land in region i. The first and second bracketed terms of equation (II.5) represents the net social benefit of an additional migrant to regions 1 and 2 respectively. The first and second terms of a region's net social benefit represent the fiscal externality and rent sharing effect respectively. At the optimum, the net social benefit from further migration should equal zero. Note that equation (II.5) is similar to the optimality conditions derived in earlier models and discussed above.

The social optimum can be restored with a corrective equalization transfer, E, chosen to satisfy the condition:

$$\left(\frac{(1-\alpha)G_1 - R_1 + E}{L_1}\right) = \left(\frac{(1-\alpha)G_2 - R_2 - E}{L_2}\right) \quad .$$

Rearranging, the following expression is derived:

(II.6) $$E = \frac{L_1 L_2}{(L_1+L_2)}\left(\left(\frac{(1-\alpha)G_1}{L_1} - \frac{(1-\alpha)G_2}{L_2}\right) + \left(\frac{R_1}{L_1} - \frac{R_2}{L_2}\right)\right) \quad .$$

The corrective transfer, E, differs from the corrective transfer, V, required in the FHM model in that head taxes, not income taxes, are used in the Boadway/Flatters model and this more recent model includes rent sharing and congestion.

Boadway and Flatters extend the model to include capital, the stock of which is fixed and the rate of return endogenously determined. Since individuals own an equal share of the economy's land and capital, there is no longer public ownership in the model. Regional authorities finance public expenditures with proportional taxes, τ_i, τ_i^R, τ_i^K, and τ_i^P on labour income, locally-generated rents, capital income, and property income (defined as after-tax income from land and capital) respectively.

The migration equilibrium is given by the solution to a multi-equation system consisting of a first order condition for each fiscal instrument in the two regions, the equal utilities condition and the equal after-tax rate of return on capital condition. While the region's choice of tax policy is not explicitly modelled, the conditions for an optimal distribution of resources, derived from the planner's problem, are:

$$L_i \cdot {}_iU_G - {}_iU_x = 0 \quad , \tag{II.7}$$

$$F_1^K = F_2^K \quad , \tag{II.8}$$

$$F_1^L - x_1 = F_2^L - x_2 \quad . \tag{II.9}$$

${}_iU_G$ and ${}_iU_x$ are the derivatives of the utility function of a representative individual in region i with respect to the public good, G, and the private good, x, respectively, and F_i^s is the marginal product of factor $s \in \{L, K\}$ in region i. Equation (II.7) is the

Samuelson condition for optimal public goods provision and is satisfied when governments behave optimally. Equations (II.8) and (II.9) state the efficiency conditions for the regional allocation of capital and labour respectively.

Making the appropriate substitutions, equation (II.9) can be written as:

$$\text{(II.10)} \quad \left(\frac{(1-\alpha)G_1}{L_1} - \frac{\tau_1^R R_1}{L_1} - \frac{\tau_1^K F_1^K K_1}{L_1} \right) = \left(\frac{(1-\alpha)G_2}{L_2} - \frac{\tau_2^R R_2}{L_2} - \frac{\tau_2^K F_2^K K_2}{L_2} \right) .$$

The interregional transfer required to ensure an optimal distribution of labour, derived as above, is:

$$\text{(II.11)} \quad E = \frac{L_1 L_2}{L_1 + L_2} \left(\left(\frac{G_2(1-\alpha)}{L_2} - \frac{G_1(1-\alpha)}{L_1} \right) + \left(\frac{\tau_1^R R_1}{L_1} - \frac{\tau_2^R R_2}{L_2} \right) + \left(\frac{\tau_1^K F_1^K K_1}{L_1} - \frac{\tau_2^K F_2^K K_2}{L_2} \right) \right) .$$

In this case, the optimal transfer eliminates differences in the fiscal externality (the reduction in the per capita tax bill net of congestion costs), public rent sharing, and capital tax collections that distort the regional allocation of labour.

Note that only source-based taxes, τ_i^R and τ_i^K, enter this condition. Residency-based taxes, like wage and property taxes, do not enter directly into equation (II.11) since these are assumed to be determined residually as the difference between total government expenditures and all other revenues. Since all residents are identical, the residency-based taxes on property and income simply represent residents' payments to themselves and do not distort migration decisions. In addition, the distortion in the regional allocation of capital is not eliminated by the interregional transfer since satisfaction of equation (II.11) does not ensure that equation (II.8) is also satisfied. As long as tax rates on capital differ, the inefficiency in the allocation of capital remains.[10]

Finally, Boadway and Flatters modify their model to incorporate heterogeneity with respect to individuals' labour endowments to consider the effects of regional redistributive policy. Proportional income taxes are levied to finance a quasi-private good distributed on an equal per capita basis. In this context, Boadway and Flatters demonstrate that the optimum is achieved only if residency-based tax revenues are equalized along with all source-based revenues. While residents receive the same amount of the quasi-private good, heterogenous individuals' tax contributions differ. As the gain from redistribution may differ across residents and regions, migration decisions can be distorted by differences in residency-based taxes. Since there are no public goods in this case, the optimal allocation of labour corresponds with the efficient allocation of labour. If both source-based and residency-based revenues are equalized, the marginal product of labour is identical in both regions and the allocation of labour is efficient. Equalization in this case also eliminates any differences in regional levels of public goods provision or tax rates.[11]

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[10] Boadway and Flatters note that two policy instruments are required to achieve efficiency in resource allocation: equalization as described by equation (II.11) and some discriminatory tax on capital. If the only available instrument is lumpsum interregional transfers, it is unlikely that the equalization given by (II.11) achieves a second best allocation. In particular, it may be necessary to encourage labour to migrate to a region where capital is underutilized. This goal may not be consistent with complete equalization of regional differentials in net fiscal benefits. This issue is examined in more detail in Tarzwell (1991) discussed below.

Boadway and Flatters acknowledge some problems associated with using equalization payments to achieve the optimal distribution of labour. For example, full equalization of residency-based revenues precludes regional governments from undertaking any redistributive policy. Moreover, full equalization of rents may eliminate the incentive for regions to tax rents although this is a non-distortionary method of raising revenue. These problems emphasize the potential for equalization to supplant regional decentralized decision-making, a cornerstone of federal systems, and raises the question of why regional governments exist and why regional governments "participate" in federations and equalization schemes.

The central conclusion that emerges from the equalization literature is that the optimal allocation of labour across regions cannot be obtained given decentralized regional decision-making and free mobility. An interregional transfer dependent on the relative fiscal externalities and the degree of public rent sharing in each region is necessary to restore the Pareto optimal allocation of labour. The more recent literature has focused on refinements to the regional structure. In particular, there has been much emphasis on modifying regional behaviourial assumptions and the choice sets available to regional authorities. Several recent papers examine the issue of regional "participation" indirectly by examining regional incentives to voluntarily make interregional transfers.

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[11] This conclusion implies that regional governments' behaviour is not altered by the equalization scheme. In other words, regional governments choose their fiscal variables in the same manner whether or not equalization occurs.

Set of Available Fiscal Instruments

Some argue that the inefficiency results obtained in this earlier literature stem from restrictions on or inappropriately specified regional fiscal instruments. Wildasin (1980) argues that interregional transfers are required in these models because regions tax mobile factors to obtain revenues for public expenditures. Taxes on immobile factors, on the other hand, do not result in locational inefficiency. To show this, Wildasin compares the migration equilibrium under three exclusive financing methods: wage taxation, benefit taxation, and land taxation. All individuals have endowments of land from each region and the level of public expenditures is assumed to be fixed in both regions.

Given these assumptions, land taxation is the only tax regime that ensures individuals are located efficiently across regions since only in this case is it impossible to avoid taxes by migration. Wildasin concludes that the locational inefficiencies discussed in the FHM-type models are generated by taxation of mobile factors and can be removed if regional authorities have available the necessary tax instruments to tax immobile and regionally fixed factors. If the public good is congestible, then the optimum is attainable as a free migration equilibrium if regional governments impose a Pigovian corrective tax on individuals and finance the remaining public expenditures using a nondistortionary tax on land. Myers (1990), discussed below, demonstrates that if regions are permitted a fiscal instrument allowing resources to be transferred from a region, the free migration equilibrium in a fiscal externality model with taxes on mobile labour achieves the optimal allocation.

Non-myopic Behaviour and Public Goods Provision

In the early literature regional authorities choose the level of the public good to maximize the utility of a representative individual taking the region's population as fixed. In models where the number of regions is small, regional authorities are likely to be non-myopic or cognizant of the migration consequences of their fiscal decisions. Stiglitz (1977) examines public goods provision in a fiscal externality model when regions are non-myopic. Whether public goods provision in the non-myopic equilibrium is greater or less than the Samuelson or myopic level is shown to depend on voters' perceived relationship between population and public expenditures, given as $\partial L_i/\partial G_i$. This perceived migration response function captures the tax externalities generated by Tiebout migration.[12] The implications of voter myopia are considered in more detail in Starrett (1980) and Boadway (1982).

Starrett (1980) focuses on the effects of myopia and alternative methods of financing public expenditures on regional incentives to provide the public good. Fiscal decentralization and fiscally-induced migration are central features in a Tiebout-type world and Starrett argues the assumption of myopic regional governments is inconsistent with the Tiebout structure of the fiscal externality models. Starrett develops a sophisticated model with a market for land and explicit consideration of congestion and access costs to public goods consumption. Heterogeneity of individuals is also embedded in the model's structure. Starrett finds that non-myopic authorities have incentives to over-expand provision of the public good relative to the optimal level when expenditures are financed by direct taxation. For the case of property tax financing, non-myopic regional governments may over or under provide the public good relative to the optimal level, depending on the sign of the migration response function, $\partial L_i/\partial G_i$, and on the relative magnitudes of the tax and congestion externalities.

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[12] Only head taxes are considered in this simple model. When combined with the additional assumptions of a fixed labour supply and of identical individuals, the head tax is non-distortionary to the labour-consumption choice. Since these head taxes are avoidable by migration they can, however, distort the location decision and it is this effect that is captured in the term, $\partial L_i/\partial G_i$.

While Starrett's analysis raises an interesting question about the effect of government myopia on public goods provision, the model is quite complex. As a result, the migration response function, critical to determining regional governments' incentives to provide public goods, cannot be explicitly derived although it is assumed to be positive throughout most of Starrett's discussion. To determine whether non-myopic communities overspend, knowledge of governments' perceived migration responses is required.

Boadway (1982) offers a simplified model closely akin to the Stiglitz (1977) and FHM models to overcome this difficulty. Like Starrett's model, interregional transfers are not considered. Assuming individuals are identical, Boadway compares the myopic and non-myopic equilibria with the social optimum under direct taxation and property taxation. In this manner, the incentive effects on public goods provision of these two methods of financing (not addressed directly in either the Stiglitz or Starrett models) can be isolated.

In Boadway's model, individuals are perfectly mobile; hence the migration equilibrium must satisfy the equal utilities condition. To determine whether non-myopic governments over or under provide the public good, the socially optimal levels of provision under the two financing methods, direct and property taxation, are derived. For the case of direct taxation, the planner's problem is to choose the level of public goods provision in both regions to maximize the utility of individuals in region 1 given the equal utilities condition. This problem is formalized as:

$$\underset{G_1,\, G_2}{\mathit{maximize}} \quad U(x_1^h,\, G_1) + \lambda\left(U(x_1^h, G_1) - U(x_2^h, G_2)\right) \quad .$$

Since individuals are identical, the h superscript can be dropped.

The solution to this problem yields a first order condition dependent on the migration response function, $\partial L_i/\partial G_i$, derived by totally differentiating the equal utilities condition with respect to L_i and G_i and rearranging to obtain:

$$\text{(II.12)} \qquad \frac{\partial L_i}{\partial G_i} = \frac{-\left({}_iU_G - \dfrac{{}_iU_x}{L_i}\right)}{{}_iU_x \dfrac{\partial x_i}{\partial L_i} - {}_jU_x \dfrac{\partial x_j}{\partial L_i}} \quad .$$

Substitution of equation (II.12) into the first order condition to the planner's problem yields the traditional Samuelson rule for optimal public goods provision.

Following the procedure outlined above, the socially optimal level of public goods provision is derived given property tax financing. A property tax, when combined with the assumption of a fixed amount of land, is equivalent to a tax on rents in the Boadway model. Boadway shows that the optimal level of the public good is given by a modified Samuelson rule that includes the migration effects and an adjustment for the nature of incidence of the property tax.[13] Since the tax burden in region i is partly borne by non-resident property owners, the optimal provision rule takes into account the impact of any tax exporting on the welfare of both residents and non-residents.

Having derived the conditions for optimal public goods provision under both direct and property tax financing, Boadway derives the conditions that characterize provision in the myopic and non-myopic equilibria in each financing regime. Boadway shows that the first order condition to the myopic government's maximization problem under a direct taxation regime is given by the Samuelson rule. When regional authorities are non-myopic with respect to the migration effects of their fiscal choices, the condition governing public goods provision is also identical to the Samuelson rule and provision is optimal. Thus, when head taxes are used to finance public expenditures, both myopic and non-myopic behaviour are consistent with public goods provision at the socially optimal level.

Relative to the optimum in the property tax regime, the myopic equilibrium leads to over provision. Optimal provision is restored, however, when regional governments are assumed to be non-myopic and Nash-competeing.[14] When property taxes are used to finance public expenditures and individuals share in both regions' rents, a myopic government, taking its population as fixed, believes it can shift some of the property tax to non-residents. Thus, the government believes that it can increase the utility of its residents by increasing the level of public goods provision in the region. Given the equal utilities condition, any myopic behaviour that decreases the utility of individuals elsewhere, in fact, lowers the utility of all individuals.

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[13] Boadway (1982) notes that the traditional Samuelson condition is, however, restored as the optimal public goods provision rule if interregional transfers are allowed.

[14] Regional authorities in this model take the other region's fiscal choices as given when choosing their own public goods provision. Hence, behaviour is Nash and

Non-myopic governments, aware that fiscal decisions affect migration, also recognize the equal utilities constraint. Any action on the part of the regional authority that reduces the utility of non-residents also reduces the utility of its own residents. Non-myopic governments realize that attempts to export taxes only serves to decrease utility within the region. Consequently, non-myopic authorities incorporate the effect of their actions on utility elsewhere, no tax shifting occurs, and optimality in the provision of public goods is restored. In contrast, no tax shifting is possible in the direct tax regime. Both myopic and non-myopic behaviour results in the optimal level of public goods provision whether or not regions are aware of the complete incentive equivalence imposed by the equal utilities condition. Thus, Boadway demonstrates that assumptions regarding government myopia and the method of financing public expenditures matter for public goods provision.

Non-myopic Behaviour and Voluntary Transfers

Recent fiscal externality models focus attention on regional government incentives to make voluntary interregional transfers in alternative settings and whether

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regions are said to be Nash competitors.

these transfers are sufficient to restore the optimal allocation. Since, in these models, voluntary transfers are a mechanism for affecting a region's population of mobile labour, regional governments are assumed to be non-myopic. The inefficiency result found in much of the earlier literature is viewed as stemming from misspecified or inappropriately assigned policy instruments available to regional governments rather than from government myopia per se. The central conclusion from Myers (1990), for example, is complete incentive equivalence imposed by the equal utilities condition on non-myopic governments implies that the optimal population distribution is achieved through voluntary interregional transfers. The migration equilibrium is optimal and no centrally-coerced transfers, like those suggested in FHM and Boadway and Flatters, are required in this context.

Myers (1990) uses a model identical to the simple Boadway and Flatters model, except in two respects, to examine regional governments' incentives to make voluntary transfers. Regional governments are assumed to be non-myopic and, by introducing both a head tax and a land tax to finance public expenditures, an additional fiscal instrument is created allowing a region to voluntarily transfer income out of the region. In contrast to earlier models, Myers allows both tax rates and the level of public good to be choice variables for regional authorities while maintaining the standard assumptions of costless mobility and individual homogeneity. In addition, individuals are assumed to own equal shares of land in both regions.

In Myers' model, region i's government maximizes the utility of a representative resident by choosing the level of the public good, G_i, a head tax, τ_i^h, and the tax rate, τ_i^T, on land. Behaviour is strategic since regions are aware that their fiscal choices influence population size and the welfare of residents in both regions. Modelling government behaviour in this way builds on the related literature focusing on non-myopic behaviour and public goods provision.[15] Non-resident ownership of land implies that, in the absence of taxation, there are interregional rent flows. These outflows can, however, be directly controlled by the region's choice of τ_i^T.

Region i's government solves the following problem:

$$\underset{G_i,\ TR_{ij}}{maximize} \quad U(x_i, G_i) + \lambda[U(x_1, G_1) - U(x_2, G_2)]$$

where

$$TR_{ij} = \frac{L_j(R_i - \tau_i^T T_i)}{L} \quad ,$$

$$x_i = \frac{F(L_i, T_i) - G_i - TR_{ij} + TR_{ji}}{L_i} \quad ,$$

and where $TR_{ij} \geq 0$, $i = \{1,2\}$ and $j = \{2,1\}$. T_i and L represent region i's endowment of land and the economy's fixed supply of labour respectively while $F(\cdot)$ represents output produced in region i. Although TR_{ij} is chosen explicitly by regional governments, TR_{ij} can be implicitly determined by region i's choice of τ_i^T. The term, $(R_i - \tau_i^T T_i)/L$, is the net-of-tax rent share accruing to all individuals. Multiplying this by L_j gives the total amount of rent transferred from region i to region j. Regional authorities behave as Nash competitors and take the other region's choice variables as given.

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[15] See the discussion of Stiglitz (1977), Starrett (1980) and Boadway (1982) presented earlier in this section.

The Kuhn Tucker conditions to region i's maximization problem are:

$$\text{(II.13)} \qquad \left({}_iU_G - \frac{{}_iU_x}{L_i} \right) + \left({}_iU_x \frac{\partial x_i}{\partial L_i} \frac{\partial L_i}{\partial G_i} \right) \leq 0 \text{ , } G_i \geq 0 \textit{ and } G_i \frac{\partial U}{\partial G_i} = 0 \text{ ,}$$

and

$$\text{(II.14)} \qquad \frac{-{}_iU_x}{L_i} + \left({}_iU_x \frac{\partial x_i}{\partial L_i} \frac{\partial L_i}{\partial TR_{ij}} \right) \leq 0, \; TR_{ij} \geq 0 \textit{ and } TR_{ij} \frac{\partial U}{\partial TR_{ij}} = 0 \text{ .}$$

The two terms in the first bracketed expression in equation (II.13) represent the direct marginal benefit and marginal cost of the public good, respectively, for an individual in region i. The second bracketed term represents the indirect utility effect from fiscally-induced migration with respect to the region's choice of public goods provision. The magnitude of fiscally-induced migration is given by the perceived migration response, $\partial L_i/\partial G_i$. Similarly, the first term in equation (II.14) is the marginal cost of region i's voluntary transfer. The second term represents the marginal benefit of the transfer or the indirect utility effect from fiscally-induced migration with respect to the region's choice of transfer.

The indirect effect of fiscally-induced migration through changes in either choice variable depends on the extent to which changes in regional variables affect a region's mobile population. The equal utilities condition implicitly determines the regional populations and the following migration response functions:[16]

(II.15) $$\frac{\partial L_i}{\partial G_i} = \frac{-\left({}_iU_G - \frac{{}_iU_x}{L_i}\right)}{{}_iU_x\frac{\partial x_i}{\partial L_i} - {}_jU_x\frac{\partial x_j}{\partial L_i}}$$

and

(II.16) $$\frac{\partial L_i}{\partial TR_{ij}} = \frac{\left(\frac{{}_iU_x}{L_i} + \frac{{}_jU_x}{L_j}\right)}{{}_iU_x\frac{\partial x_i}{\partial L_i} - {}_jU_x\frac{\partial x_j}{\partial L_i}}$$

Substitution of the perceived migration responses into the first order conditions for G_i and TR_{ij} shows that the Nash equilibrium necessarily involves a positive transfer for one region and a zero transfer for the other. Myers also shows that this net interregional transfer is identical to the optimal transfer derived in Boadway and Flatters (1982) or equation (II.6) in this chapter when $\alpha = 0$. Thus, the Nash equilibrium is optimal.[17] In addition, the condition governing public goods provision by non-myopic regional authorities collapses to the traditional Samuelson condition.

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[16] This approach is developed in Stiglitz (1977) for the case where there are no voluntary transfers. A description of this technique is provided in the discussion of Boadway (1982) presented earlier in this section.

[17] Krelove (1988) derives a similar result in the context of a rent-maximizing regional government.

Stiglitz (1977), who also finds a similar result regarding efficiency in equilibrium when voluntary transfer are made, predicts that this result breaks down in the multiple region case as a result of free riding. Myers, however, shows that his result continues to hold in the multiple region case provided that a separate transfer instrument for each regional transfer is available. For example, suppose a region wishes to make voluntary transfers of different magnitudes to two regions. If voluntary transfers are implicitly made through a region's choice of land tax, and if this land tax cannot be differentiated on the basis of a landowner's region of residence, then the regional authority lacks sufficient instruments to make different transfers and Myers' result breaks down.

Costly Mobility

Recent contributions extend Myers' analysis to consider the effects of costly mobility and individual heterogeneity on regional governments' incentives to make voluntary transfers. By introducing mobility costs and stochastic labour productivity into a fiscal externality framework, Hercowitz and Pines (1991) explore further regional governments' incentives to make efficiency-enhancing transfers. As above, transfers are aimed at influencing the size of a region's population, so regional authorities are non-myopic. The assumption of individual homogeneity is maintained and there are no public goods in this two region model. One region is assigned the property rights to rents generated within its borders and the regional authority must choose rent shares for its own residents and the residents of the other region.

The model demonstrates that while regional authorities may have incentives to make transfers (i.e. choose a positive rent share for non-residents), these transfers are generally insufficient to achieve an optimal allocation of labour. The social optimum requires that interregional differences in rent shares be eliminated in equilibrium. In conclusion, the authors argue that the efficient allocation of labour cannot be achieved in this setting without centrally-coerced transfers. When mobility costs are absent, the static Myers result is shown to hold in this dynamic context and regions have the appropriate incentives to voluntarily make the transfers necessary to achieve the optimum.

Adopting the assumption that individuals have varying degrees of attachment to a particular region, Mansoorian and Myers (1993) analyze the effects of a different type of mobility "cost" on public goods provision and the migration equilibrium. Attachment to home correspondingly reduces the amount of migration that can be fiscally-induced with a given level of transfer and, therefore, reduces the benefit of a transfer. Although complete incentive equivalence is broken by individuals' attachment to home and, in general, leads to regional disagreement over the allocation of resources, the migration equilibrium (with or without transfers) is Pareto efficient. Like Myers (1990), public goods in this model are provided according to the Samuelson condition.

Voluntary transfers represent a mechanism by which regional governments can purchase their preferred population and, as such, may occur in equilibrium, although Mansoorian and Myers (1993) find a range of initial endowments over which both regions prefer larger populations. Hence, neither region prefers to make a transfer. In contrast to Myers (1990), voluntary transfers need not exist in equilibrium.

In the Mansoorian and Myers model, individuals differ only with respect to their attachment to home and, therefore, residents' preferences for the local public good are identical. Thus, the regional government simply maximizes the utility of a representative individual in the region and, in doing so, maximizes the utility of all residents. Like much of the fiscal externality literature, this approach ignores individual heterogeneity that gives rise to diverse preferences for the fiscal package within a region. When intraregional preferences differ, a collective or social choice mechanism for determining the fiscal package is necessary to reconcile this diversity. In models where such diversity exists, the focus tends to be on the incentives of regional governments to explicitly redistribute income. For example, in models with majority voting, the ability of local governments to redistribute income is examined when individuals are mobile and income is location-independent.[18]. However, since income is independent of location, we are removed from the fiscal externality context.

Redistribution in a Fiscal Externality Model

Diversity and redistribution are considered in the fiscal externality framework in Burbidge and Myers (1994).[19]. With the introduction of differences in individual preferences and productivity. Burbidge and Myers examine redistribution within and across regions when individuals are perfectly mobile and income is endogenous. Regional governments' preferences for redistribution between the region's residents are exogenous and captured by a generalized social welfare function. The results show that when regions undertake redistribution and regions' preferences for redistribution are identical, the migration equilibrium is optimal although interregional transfers usually occur in equilibrium. When regional preferences for redistribution differ, voluntary transfers may or may not occur but efficiency in the regional allocation of labour is generally not achieved.

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[18] For example, see Brown and Oates (1987) and Epple and Romer (1991) briefly discussed in the review of majority voting models presented in section II.2 of this chapter.

[19] Wildasin (1994) also examines the ability of regions to pursue within-region income redistribution in a model with migration and no public goods. In this context, if regions can make voluntary payments to non-residents and if these payments reduce immigration of potential redistribution beneficiaries to the region, the region can

Redistribution in the Burbidge and Myers model refers to the shares of regional rents transferred to each individual type as determined by the regional authority. Non-myopic regions are aware of the inefficiencies associated with non-optimal provision of public goods and are shown to select rent shares while choosing the public good optimally. The model demonstrate that while public goods provision is optimal (i.e. satisfies the Samuelson condition) the distribution of the population in the migration equilibrium is suboptimal except when regional preferences for redistribution are identical. The optimum is achieved when regional preferences for redistribution are the same as a result of complete incentive equivalence.

Suppose region i's social welfare function is defined as $W_i(U_i^A, U_i^B)$ where A and B denote different types of individuals. Having identical preferences for

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pursue its preferred redistributive income policy without altering the interregional allocation of labour.

redistribution implies that $W_i = W_j$. When a non-myopic region i chooses its fiscal package to maximize W_i, taking into account the equal utilities condition for individuals of a given type, the region recognizes that this choice also maximizes W_j. In this case, any mutually beneficial interregional transfers are voluntarily agreed to by both authorities. Complete incentive equivalence implies that regions agree over the distribution of the economy's resources. When regional preferences differ, this complete incentive equivalence is broken. As a result, regional government decisions lead to differential treatment of individuals across regions, distorting individual migration. While voluntary transfers may occur in equilibrium, these transfers are made in pursuit of a region's particular preference for redistribution and, as such, do not eliminate regional differences in preferential treatment of individuals.

In conclusion, Burbidge and Myers demonstrate that intervention by an external authority would be required to achieve an optimal allocation but that the traditional equalization transfer (a lump-sum interregional transfer) is not the appropriate corrective measure. A central authority must be able to differentiate by type of individual and by region of residence so that residency-based taxes are equalized across regions for each type of individual.

The literature reviewed above focuses on the efficiency rationale for interregional transfers and the lack of appropriate incentives for regions to make the necessary transfers voluntarily. Under some circumstances, an external authority with the ability to make interregional, or is some cases interpersonal, transfers is required to ensure an optimal distribution of population. The issue of regional participation in a federal system with centrally-coerced transfers cannot, however, be addressed in the framework of existing fiscal externality models. While a central government may be required, little attention is given to the nature or characteristics of such an authority. These characteristics are likely to be important determinants that constrain or otherwise define an external authority's ability to make transfers. Furthermore, existing fiscal externality models do not capture the nature of some federal systems where regional and federal governments have, to some extent, separate spheres of influence and responsibility. For example, equalization in Canada is enshrined in the *Constitution Act, 1982* as a federal responsibility. Political reality, however, places constraints on the federal government with respect to taxation and treatment of the provinces. The significance of some of these constraints for equalization can be explored in a regional model that explicitly introduces a federal authority responsible for eliminating the inefficiencies created by fiscally-induced migration. Recent work presented in Tarzwell (1991) proceeds in this direction by explicitly introducing a federal authority into a regional model with migration.

Introduction of a Federal Authority

Tarzwell (1991) considers the implications of distortionary regional taxation in a fiscal externality model with costless mobility. As such, the model follows in the tradition of models with fiscally-induced migration as the efficiency rationale for interregional transfers. In Tarzwell's two region model, the federal authority is assigned the responsibility for efficiency-enhancing transfers and the implications of constraints on the federal authority are explored. Using this basic structure, distortionary regional taxation and fiscally-induced migration are examined in the presence of foreign ownership of firms. The federal authority chooses an interregional transfer to maximize the social welfare function of the federation. Foreign ownership creates incentives for regions to tax and capture rents that would otherwise leave the region and the federation. In this model it is desirable from the federation's perspective to capture these outflows of rent. In contrast, if foreign ownership is not permitted, regional competition for rents serves only to reduce welfare and is undesirable from the federal government's perspective.

A game theoretic approach is used to examine the role of the federal authority in eliminating inefficient migration. The author first considers the case where regions impose a non-distortionary rent tax. Regions choose the tax rate to maximize the welfare of residents while the federal authority maximizes the welfare of the federation by choosing the level of interregional transfers. If there is no foreign ownership, then Nash competing regional authorities set their tax rates to zero. This equilibrium is efficient since any competition to capture rents simply redistributes rents while reducing total output. Regional governments are aware of this and so choose a zero tax rate. This is another example of the complete incentive equivalence result when behaviour is non-myopic and individuals are freely mobile.

With some degree of foreign ownership, it is efficient for the federation to retain all rents flowing to foreigners using non-distortionary taxation and for any differences in net fiscal benefits across regions to be eliminated using an interregional transfer. In the absence of a federal government, however, Nash competing authorities may find it optimal to choose a tax rate less than 100%. This leads to an interregional flow of rent as well as a rent outflow from the federation to foreigners. Although taxation allows the capture of rents that would otherwise escape the country, taxation also redistributes rents across regions. Since this redistribution reduces the welfare of their residents, regional governments choose to tax rents at a rate less than 100%. Introduction of a federal authority in this case ensures an efficient outcome. Since the redistribution of regional rents created by regional taxation of rents is eliminated by a federally- imposed interregional transfer, output is maximized. Thus, given a federal authority to make such transfers, regional governments set their tax rates equal to 100%. Tarzwell does not consider the case in which non-myopic regions have incentives to make voluntary rent transfers. It would be interesting to determine if this modification would eliminate the need for a federal authority.

With distortionary taxation, the tax is fully passed on to the inelastically supplied factors of production and, since the after-tax return to capital is fixed internationally, imposition of the tax reduces the employment of capital in the region and in the federation. Provinces choose the tax to equate the costs and benefits of the tax at the margin. Although the tax captures some additional rents or revenues, it lowers output due to its distortionary effects on capital and the fiscally-induced migration of labour. As long as there is a degree of foreign ownership, regions choose a tax rate somewhere between zero and 100%.

In this case, the objective of the federal authority is to balance the costs of distortionary taxation and the benefits associated with additional rent capture by encouraging the movement of labour into the province that can capture rents most effectively and into the province with the most distortionary tax. The latter helps to alleviate the underutilization of capital in this region created by distortionary taxation. As a result, in this second best world, the optimal interregional transfer is not necessarily the one which ensures equal per capita rent shares across regions.

Summary

With few exceptions, the fiscal externality literature ignores the issues of diverse preferences for the fiscal package within a region and the need for specifying a collective choice mechanism to reconcile this diversity. The model developed in chapters III and IV addresses this omission by allowing individuals' preferences to differ and by examining the effect of a particular mechanism, majority voting, on public goods provision, the migration equilibrium and the social optimum. Thus, the model extends the fiscal externality literature in a manner that is theoretically challenging and empirically relevant. In addition, none of these models allow for the possibility of an endogenously-determined federal government or federal government objective. Instead, the federal or external authority's objective of maximizing the federation's social welfare by correcting for distortions generated by private and decentralized fiscal decision-making is exogenously imposed. As noted above, an external authority with this objective and the powers necessary to achieve this objective is not consistent with the separate spheres of responsibility and the multigovernment structure common to most federations. Allowing the endogenous determination of the objective of the federal authority, as is done in the model developed in chapter V, avoids this inconsistency and highlights the possible constraints on federal government behaviour that might arise in such a model.

II.2 Majority Voting Literature

Like the fiscal externality model developed in this thesis, majority voting models examine local public goods provision when regional decisions are governed by a majority voting rule and individuals are mobile. In general, majority voting models differ from fiscal externality models in two important respects: individuals are assumed to be heterogeneous and individual income is location-independent. The assumption of location-independent income follows in the tradition of Tiebout and is appropriate in models where the area of residence need not be the same as the area of employment. However, since the model in this thesis examines public goods provision in a regional context, individual income is assumed to be endogenous as is standard in the fiscal externality approach. As noted in section II.1, fiscal externality models seldom adopt the assumption of individual heterogeneity and, as a consequence, need not specify a social choice rule or mechanism to reconcile diverse preferences. In contrast, the fiscal externality model developed in chapters III, IV, and V follows the majority voting literature by introducing intraregional diversity in individuals' preferences for the fiscal package and a majority voting rule.

Analytically and methodologically, the model presented here is most closely related to the fiscal externality literature. However, a brief review of majority voting as a public choice mechanism and the problems associated with such a rule in models with migration helps to identify similarities and potential problems that may arise when majority voting is introduced into a different environment. Many of the difficulties that arise with majority voting discussed below are avoided in the model outlined in chapters II, III, and IV by construction. However, in a more sophisticated model and in reality, the problems are likely to re-emerge. Thus, it is useful to summarize recent developments in this area.

Origins of the Majority Voting Literature: Existence, Stability and Optimality Properties

In contrast to the assumption of a benevolent government or social planner that is found in the traditional public finance literature, models of public choice focus on the individual's role in, and the rules governing, the collective decision-making process. Among the most widely discussed rules for collective choice are unanimity and majority voting. The narrow set of issues over which a unanimous voting rule can determine an outcome and the costs associated with achieving complete unanimity has shifted the emphasis of public choice models to alternative voting rules.

Even in the simplest model with no migration, however, a majority voting rule can lead to problems of non-existence and instability of equilibrium, and much of the literature has focused on these issues. For example, the standard assumptions regarding individual preferences (reflexivity, completeness and transitivity) are insufficient to ensure a unique and stable voting equilibrium when majority voting determines the outcome for a single issue. Black (1948) was the first to show that if the additional assumption of single-peaked preferences is imposed in addition to the assumptions of reflexivity, completeness and transitivity, the potential for cyclical majorities, the root cause of nonexistence and instability, is eliminated and a unique and stable equilibrium exists. It can also be demonstrated that if this condition is satisfied, the majority voting outcome will be the preferred choice of the voter with median preferences. For example, Bowen (1969) shows that majority voting yields a Pareto optimal level of public goods provision if income is symmetrically distributed and individuals have identical tax shares or, in other words, public expenditures are financed by a head tax. Bergstrom (1979) argues that local public goods are more often financed by some proportional tax system for both optimal tax and equity reasons and shows that public goods provision given majority voting is optimal if the distribution of tastes is symmetric and uncorrelated with wealth and public goods are financed by a proportional wealth tax.

Once voting applies to multidimensional issues and individuals must vote on issues simultaneously, further restrictions on preferences are necessary to ensure existence, uniqueness and stability of a majority voting equilibrium. In general, these additional restrictions exclude certain preference orderings from the feasible set. Kramer (1973) summarizes many of the exclusion restrictions proposed in the literature and Mueller (1990) provides several examples of preferences that are excluded under some of the proposed restrictions. The main implication of these results is that the restrictions on preferences necessary to achieve a majority voting equilibrium with the desired properties of uniqueness and stability are not significantly less restrictive than those implied by a unanimity rule.

When individuals have identical preferences, described by a strictly quasi-concave utility function, diversity with respect to individuals' demands for the public good are generated by differences in income only, substantially reducing the complexity of the voting problem. If voting occurs over a single issue, a unique and stable majority voting equilibrium exists. In the model presented in subsequent chapters of this thesis, all individuals are assumed to have identical preferences. While this is generally sufficient to ensure stability when no mobility exists, in a fiscal externality model with interregional migration, stability and uniqueness are no longer guaranteed. In addition, since there are only two income levels in each region, income is not symmetrically distributed around the income level of the "median" voter. Thus, as is demonstrated in chapter III, public goods provision in this model is generally not optimal.

As discussed in later chapters, migration can lead to a switch in the identity of the majority and potentially to instability in the migration equilibrium. The problem of majority switching raises an interesting question about regional government incentives to preserve the existing majority in the presence of mobility. An examination of this issue, however, requires, at the very least, a dynamic model and lies beyond the scope of the research presented in this thesis. To avoid instability and switching problems, the model's results, presented in chapters III, IV, and V, are derived for alternative population configurations such that the identity of each regional majority is unchanged by migration.

Majority voting in the context of several communities and migration promises to be a difficult challenge in light of the obstacles present in even the most simple models without migration. A literature on majority voting in the context of intercommunity migration has developed despite these difficulties. Research in this direction is motivated in part by criticisms of the classic Tiebout model. In particular, the assumptions of Tiebout imply an infinite number of potential communities. The decentralized solution in this model results in homogeneous communities where the preferences of residents with respect to the fiscal package are exactly satisfied.

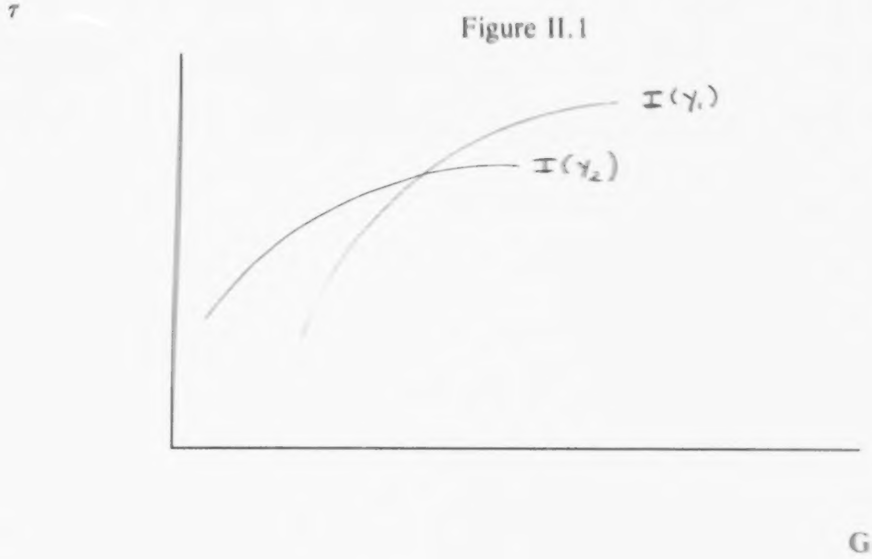
Westhoff (1977) explores the implications of the assumption that the supply of potential communities is finite and less than the number dictated by the continuum or diversity of preferences. This scarcity implies that not all individuals are able to find their optimal fiscal package, and, as a result, an intra-community decision rule must be specified. Adopting this assumption, Westhoff examines the conditions necessary to ensure existence of equilibrium when community fiscal packages are determined by majority voting and individuals are perfectly mobile.

Westhoff defines an equilibrium as an allocation of individuals over communities such that each community is in a voting equilibrium and there are no incentives for migration. A voting equilibrium requires each community to balance its budget and, given the fiscal package, at least 50 percent of the residents do not prefer more of the public good and 50 percent do not prefer less. The economy consists of one private good, one public good and a fixed number of communities. Public expenditures are financed by a proportional income tax, individual income endowments are fixed, and individuals are assumed to differ with respect to income endowments and preferences.

In Westhoff's model, existence of equilibrium requires, in addition to the standard assumptions of a strictly quasi-concave and continuous utility function, that the marginal rate of substitution given a particular choice of public good and tax rate be an increasing function of "n" where "n" indicates the income ranking of a particular individual. A higher "n" implies a higher income level for that individual. This restriction requires that the slope of individual indifference curves when mapped in the public good (G)/tax (τ) space be increasing in income. This characteristic of preferences ensures that indifference curves for any two individuals with different incomes intersect only once and that a "separating equilibrium" obtains. Figure II.1 illustrates the indifference curves for two individuals in with incomes y_1 and y_2 where $y_1 > y_2$. In other words, individuals are separated by income levels into different communities. This is the Tiebout sorting effect.

With the explicit introduction of land and a market for housing, Rose-Ackerman (1979) extends Westhoff's model and reexamines the existence and stability properties of the migration equilibrium in a model with majority voting and multiple governments. Community endowments of land are fixed and the supply of housing is assumed to be perfectly inelastic. In contrast to Westhoff's assumption of proportional income tax financing, Rose-Ackerman considers a proportional tax on individual property values. Equilibrium is defined as in Westhoff (1977) with the additional requirement that the housing market in each community clears. Rose-Ackerman shows that an equilibrium, if it exists, is described as in Westhoff (1977) and that the Westhoff assumption regarding relative preferences is necessary for existence. The author demonstrates, however, that these conditions are not sufficient

Figure II.1



for existence and stability. For example, increasing returns to scale in the production of the public good combined with strong preferences for the public good relative to housing can lead to disequilibrium and nonexistence.

Similar results are found in Epple, Filimon and Romer (1984), herein EFR. EFR relax Rose-Ackerman's assumption of a perfectly inelastic supply of housing and assume that individuals differ with respect to their fixed income endowments only. The definition of equilibrium is equivalent to that in Rose-Ackerman (1979) and Westhoff (1977) with the additional requirement that the aggregate housing market clears in each community. The necessary conditions for an equilibrium are that communities be stratified by the income levels of individuals, the boundary individual be indifferent between the two adjacent communities and that the fiscal bundles be increasing with community income. Again, the Westhoff assumption regarding relative preferences is necessary for existence of equilibrium. The authors find that stability is incompatible with a unique equilibrium without imposing additional restrictions. In particular, the authors are unable to derive the sufficient conditions for existence when the local public good is a pure public good and when the local public good is congestible but there is no fixed cost to production.

A numerical example is presented for the two community case using empirically consistent parameter estimates to further investigate stability and existence properties. Such an exercise allows the authors to determine any additional conditions necessary to ensure existence of a single, unique and stable equilibrium and the effects of relaxing some of the sufficient conditions. The results of varying the parameter values from their benchmark levels suggest that a stable and unique equilibrium exists within a wide range of values. The numerical simulations demonstrate that existence and uniqueness are possible even when there is no fixed cost of community formation. When the fixed cost is varied from its benchmark value of zero, there is evidence of multiple equilibria for small values and uniqueness of equilibrium at relatively high values for fixed costs. A highly elastic housing supply is found to increase the likelihood of non-existence of equilibrium. Thus, restrictions on this supply function may be important for ensuring the existence of equilibrium. The example also shows that a unique equilibrium is possible if the public good is pure. Slight variations in the marginal cost of provision of this pure public good can, however, produce multiple equilibria. In conclusion, these numerical simulations demonstrate that a unique equilibrium can potentially exist under conditions less restrictive than those conditions for which stability and uniqueness have been proved theoretically.

Majority Voting and Redistribution

Majority voting models have also been used to study intracommunity redistribution and the constraint that migration imposes on regional governments' ability to pursue such redistribution. The redistribution considered in these models generally takes the form of explicit income transfers. While the model developed in this thesis examines public goods provision with majority voting and no explicit within-region redistribution, implicit redistribution is possible when the majority-determined level of public good does not satisfy minority preferences and tax payments do not correspond directly with marginal benefits. As demonstrated in later chapters, migration can influence a regional majority's fiscal choice and, as a result, may limit the ability of the majority to exploit the minority through the region's fiscal package. As such, this thesis extends the majority voting literature on redistribution by relaxing the assumption of location-independent income and considering implicit redistribution through majority-determined fiscal choices. For this reason, a brief review of models of majority voting with redistribution is relevant to the findings of this research.[20]

In contrast to earlier work like Brown and Oates (1987) where redistribution is motivated by utility interdependencies, Epple and Romer (1991) develop a model where redistribution is a direct consequence of majority voting and self-interested voters.[21]. The authors consider a multijurisdiction model with migration, majority voting and fixed income endowments. Individuals differ only with respect to these income endowments. In addition, the number of regions and regional endowments of land are fixed. The revenues generated by a proportional property tax are used to provide an equal per capita transfer, g, to residents. Like the Rose-Ackerman and EFR models, migration affects the community tax base and regional populations through the housing market. These earlier models adopt the assumption that voters are myopic and take as given a community's tax base and population when voting. In contrast, Epple and Romer assume that individuals are non-myopic and are aware of the effects of the community's choice of tax and transfer on local housing prices and on migration.

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[20] No attempt is made to review the empirical studies on migration in response to differences in local redistribution.

The definition of equilibrium and the sufficient conditions for existence are analogous to those found in Rose-Ackerman (1979) and Epple, Filimon and Romer (1984). Communities must be stratified on the basis on income, individuals with the boundary income are indifferent between two adjacent communities[22] and the level of redistribution in a community declines as community income increases. If this last characteristic is not satisfied and the level of redistribution was higher in higher income communities, lower income individuals would be encouraged to migrate into these communities chasing out higher income individuals. This gives rise to problems of instability and nonexistence of equilibrium. The redistributive possibilities available to a community are defined by the equilibrium conditions for each community's housing market, community budget balance, and by the boundary indifference condition. The authors show that a majority voting equilibrium maximizes the utility of the median income voter in the community and that this point will be on the boundary of the redistribution possibilities set.

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[21] This model builds on earlier work by Romer (1975) and Meltzer and Richard (1981).

[22] Ranking communities in order of income, there exists a boundary income between the two adjacent communities.

Epple and Romer consider the effects on the equilibrium of changing the relative land endowments of communities and the mix of renters and homeowners. In the two community case, an increase in the lower income community's share of the total available land tends to increase its share of population, the income of the boundary individual and the average income of the community. Together, these changes make feasible a higher level of redistribution. With in-migration, the income of the decisive voter is, however, likely to rise. Since higher income individuals prefer less redistribution, migration can constrain the ability of the community to pursue greater redistribution. The net effect on redistribution from an increase in relative size is therefore ambiguous.

A change in the mix of renters and homeowners is also likely to have an impact on the extent of redistribution undertaken. Since homeowners are concerned with the after-tax price of housing as well as the gross price (because it affects wealth), their indifference curves are flatter around the equilibrium fiscal package. A change in the level of redistribution changes the after-tax price of housing and homeowners must include the associated capital gains or losses in their voting decisions. For example, an increase in the redistributive transfer tends to reduce the after-tax price of housing implying a capital loss for homeowners. A homeowner with the same income endowment as a renter therefore prefers a lower level of redistribution.

Epple and Romer use a three community numerical example to demonstrate the effects of a change in the tenure mix in a community and in relative land endowments. Individuals are assumed to have Cobb-Douglas utility functions and the community housing supply function is of a constant elasticity form. Of the three communities, the highest income community is assumed to set the level of redistributive transfer equal to zero. In the all renters case, when redistribution is undertaken in both the remaining communities, the results show that the middle income community chooses a relatively large transfer even when its share of land and population is small. Since the average income of this community is significantly above the mean and median for the three communities combined, Epple and Romer's model predicts a relatively small transfer compared to the low income community. The numerical results do not support this conclusion. Smallness of community does not necessarily prevent relatively high transfers even in a high income community. Intuitively, since part of the property tax used to finance the transfer is borne by absentee property owners, renters are able to shift some of the burden of redistribution to non-residents. The potential for tax shifting makes high levels of transfers attractive even in small, higher income communities.

For the owners-only case, the level of redistribution is substantially lower in the poor and middle income communities for all values of relative community size. In this case, an increase in the relative size of the low income community causes the equilibrium level of redistribution in this community to fall. As the middle income community decreases in size, the level of redistribution chosen falls. When both renters and owners are present, levels of redistribution are lower when compared to the renters only case. Epple and Romer's model suggests that housing tenure is a critical determinant of redistribution at the local level since renter and owner preferences for redistribution differ. Local redistribution also leads to a sorting of individuals (and therefore communities) by income, a feature common to those majority voting models reviewed above. This sorting effect is not present in fiscal externality models since income is endogenously determined and the number of regions is usually assumed to be small.

The model developed in subsequent chapters of this thesis is similar in some respects to the Epple and Romer model. In Epple and Romer, migration affects the level of redistribution undertaken in the community by increasing the scope for redistribution and by changing the income, and therefore the identity, of the decisive voter. Although migration is assumed to leave the identity of existing majorities unaffected in the model presented in chapters III, IV and V, migration can affect the income of the decisive voter. Since the majority's choice of public goods provision is directly influenced by income, so is the level of implicit redistribution through public goods provision directly affected.

Summary

This brief review demonstrates that the literature on majority voting in local government models focuses on issues of existence and stability of equilibrium. Unlike the fiscal externality literature and the model presented in this paper, efficiency in the allocation of labour is not an issue in most of these models. Some attention is given in the literature to the redistributive effects of a majority voting rule for local government decision-making. In particular, these models focus on the extent to which communities can pursue local redistribution given majority voting and costless mobility. The optimality properties of local public goods provision given majority voting and exogenous income are also explored. In the model developed in chapter III of this thesis, the analysis shows that regional public goods provision given majority voting and endogenous income is suboptimal unless all individuals in a region have identical incomes. The model in chapter IV further extends this literature on majority voting and redistribution in a model where income is endogenously determined and redistribution is implicit. The model examines the extent to which regional majorities can redistribute a region's resources through voluntary interregional transfers when regions are comprised of both mobile and immobile individuals and the effects of migration on regional majorities' incentives to make such transfers.

II.3. The Optimal Design of A Constitution

The fiscal externality and majority voting literatures focus on government decision-making when regions have authority over the provision of local public goods but limited, if any, control over immigration. As noted, a federal type of government structure or an external authority with power over local jurisdictions is sometimes presumed to exist in these models. In contrast, the optimal design literature searches for answers to the following questions: what is the optimal structure of government, what is the optimal allocation of powers and responsibilities, and how does the equilibrium or existing structure of government compare to the optimal design? While this literature is diverse and spans several disciplines including economics, history, political science and law, the discussion presented here is limited to economic models and comparisons of constitutional design.

Three broad approaches to the issue of optimal constitutional design are evident in the literature. The traditional public finance approach focuses attention on questions of the optimal constitutional structure and the optimal allocation of functions and seeks to determine the Pareto optimal constitutional design. An alternative to this approach has been to examine how existing constitutional designs compare to the optimum and, using a second best approach, how a reassignment of functions and responsibilities might improve upon the existing arrangement. Finally, the contractarian view examines constitutional design from the perspective of individuals as if they are behind a veil of ignorance. Thus, in this approach, uncertainty and information at the time of constitutional design exert a significant influence on the optimal design.

This thesis adopts a contractarian model of optimal constitutional design and examines the constitution that emerges in equilibrium.[23] The work presented here is most closely related to the literature that examines the influence of uncertainty on optimal design and, as such, this review focuses primarily on the recent contributions to the contractarian approach. For completeness, the other approaches are first briefly summarized using examples followed by a more detailed examination of the contractarian view of constitutional design.

Traditional Approach

To explain the existence of a federal or multilevel government structure, early discussions in the public finance literature, advocating a greater or lesser degree of centralization of the public sector, centred around the presence of market failures, diverse preferences and equity considerations. These rationales are briefly outlined below.

Diversity of Preferences, Economies of Scale and Externalities

Diversity of preferences for local public goods has often been proposed to justify a decentralized government structure. In this context, decentralization permits a greater diversity of fiscal packages across regions or locales and reduces the extent to which diverse preferences are not satisfied. Since many public goods are local in nature, the proponents of this view argue that efficiency in provision is best achieved by assigning responsibility for provision to the local level. This is the argument found in Tiebout (1956), discussed in section II.1, and Oates (1972), and is implicit in the majority voting and fiscal externality literatures. In these models, centralization is assumed to be synonymous with uniform provision of public goods.

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[23] The contractarian model is attributed most often to Buchanan and Tullock (1962) and Rawls (1971).

Market failures, arising from economies of scale in public goods provision, spillovers and externalities, have also been used to motivate the existence of government and to explain the existence of multiple levels of government. The span or degree of these market failures determines whether a particular function, like public goods provision, regulation, or revenue collection, is best allocated to one order of government or another. Economies of scale in the administration and collection of tax revenues is the primary efficiency argument for allocating the revenue collection function to a central government. Empirical studies suggest that police and fire protection services, for example, exhibit low levels of publicness and, consequently, responsibility for these functions should be allocated to lower levels of government.

Transactions Costs

Many of these proposed allocations of functions are neatly captured in a single framework. Breton and Scott (1978) use transactions costs analysis to examine the assignment, and the potential for reassignment, of functions to particular levels of government. Since initial assignment or constitutional design is determined by political and historical forces, perhaps more so than economic forces, Breton and Scott concentrate on the implications of transactions cost minimization for the reassignment of functions. In this model, individuals incur two types of transactions costs: signalling and mobility. Signalling, to inform politicians of individuals' preferences for public goods, is necessary but costly. Individuals are willing to invest in signalling in order to reduce the degree of coercion or frustration suffered from not having their preferences satisfied. Breton and Scott adopt the hypothesis that greater decentralization of the public sector leads to a smaller variance of preferences within each jurisdiction and, all else equal, a lower level of frustration. Thus, signalling investment is inversely related to the degree of decentralization. Migration represents another form of signalling.

Governments are assumed to face both administration and coordination costs. Administration costs are those incurred in the performance of government activity and the provision of government services. While administration costs are generally specific to a particular government, coordination costs usually depend on more than one government. To deal with spillovers and externalities generated by public or private sector activity, coordination between governments is required and this activity is costly. Joint ventures, trade exchanges, and local public goods with spillover effects are examples of activities on which different governments may coordinate. In Breton and Scott's framework, it is the presence of and the relative magnitudes of these transactions costs, not the existence of public goods, spillovers and externalities per se, that determines the particular government structure to emerge.

In Breton and Scott's model, constituent assemblies choose the assignment of functions that minimizes the transaction costs of government and individuals.

Coordination between governments necessary to cope with interjurisdictional spillovers in pollution, for example, may result in a federal structure characterized by intergovernmental and interjurisdictional payments. Since negotiation is costly, these payments may be institutionalized in the constitution as a type of grant, conditional in nature. Breton and Scott point to decentralized expenditure decisions and centralized collection of income tax revenue and the revenue transfers between government levels as the outcome of a transactions costs minimization problem. In particular, in their model, redistribution should likely be assigned to the central government to minimize potentially large migration and coordination costs.

Equity Considerations

Equity is another important rationale for government proposed in the literature. Since equity usually involves some form of redistribution through explicit income transfers or implicitly through the provision of public goods and the tax system, the optimal design of the constitution must determine the assignment of the redistributive function. In contrast to assignment issues related to market failures and diversity of preferences, assignment of the redistributive function is perhaps the most controversial issue since the optimal assignment is directly related to one's views regarding the appropriate universe for redistribution - local, regional, or national. As discussed in section II.2, labour mobility can constrain local governments in their pursuit of local redistributive objectives. Thus, the optimal assignment of redistribution may involve trading off the benefits and costs associated with allocation to a particular level of government.

Boadway and Hobson (1993), for example, adopt the view that national equity considerations are central to redistribution in Canada and, as a result, the federal government should occupy a dominant position with respect to this function. Boadway (1992) argues that there is a market failure in the private market for insurance with respect to being "unlucky at birth". Boadway defines social insurance as redistribution based on characteristics such as location at birth, employment status, or physical characteristics. Since private insurance must be purchased before the event being insured against occurs or is revealed, and since individuals do not have sufficient capital at birth to purchase such insurance, there is a market failure. If compensation for being "unlucky at birth" is determined from behind a Rawlsian veil of ignorance, Boadway argues that a central or national government would adopt the social insurance or redistribution function. In contrast, Boothe (1992) adopts a diversity of preferences approach to equity and redistribution. Boothe assumes that individual preferences for redistribution are more similar the closer (geographically) these individuals are to each other. In other words, preferences for redistribution are diverse but locally homogeneous. Taking this view, the optimal design assigns the redistribution function to local governments.

Comparisons of Existing Constitutional Designs With the Optimum

Boadway (1992) also draws upon these traditional public finance arguments when comparing an optimal constitutional division of powers to Canada's actual constitutional assignment. While transaction costs are not explicit in his analysis, Boadway makes reference to the need to balance the benefits and costs of decentralization. Among the reasons for government listed by Boadway are economies of scale, externalities, public goods and social insurance. The latter rationale, social insurance, refers to redistribution based on individuals' endowments defined over characteristics such as location at birth, employment status, health and physical characteristics. Since private insurance can be purchased only before the event against which one is being insured occurs, insurance against such endowment risks cannot be obtained. Consequently, there exists a role for the public sector to provide such insurance after the fact. Boadway argues that in a federal state redistribution to provide such social insurance is often motivated by assuming individuals decide on redistribution from behind a veil of ignorance. Boadway notes that one's beliefs about equity are critical in determining whether or not to centralize the redistributive function. If equity concerns are proportional to geographic proximity, for example, then redistribution should be assigned to the local level. If, however, equity considerations span across several regions, then the function should be allocated to the federal level of government.

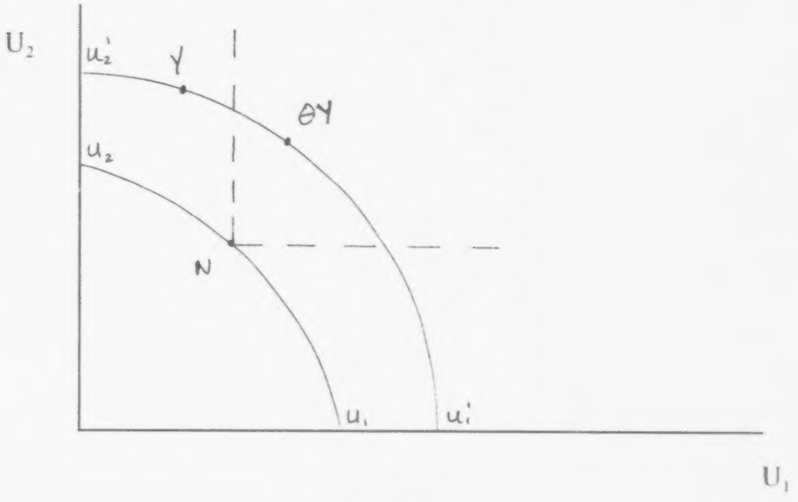
Risk Aversion and Uncertainty: The Contractarian View

While representing a valuable contribution to the constitutional design question, the approaches outlined above offer more of a patchwork or piecemeal approach to the question of optimal design and apply only in a very limited sense to the model adopted in this thesis. In this thesis, since regions taken as given their power to levy taxes and provide a local public good, a status quo of decentralization exists and is exogenous to the model. In the extended model in chapter V, uncertainty is introduced and the model examines whether this uncertainty creates incentives for regional governments to "federate" where the type of federation is determined by the ex-ante choice of interregional transfer. This approach is closely related to the contractarian view of constitutional design.

The contractarian view examines constitutional design from the perspective of individuals as if they are behind a Rawlsian veil of ignorance. As such, uncertainty is an important factor in the optimal design question. This approach is used in Buchanan and Tullock (1962) to motivate a role for government in redistribution. Boadway (1992) also appeals to this approach when proposing a number of general characteristics that might be included in a constitution, including social insurance. More recently, this approach is used in Barbosa and Jovanovic (1991) to examine a constitution that specifies the extent of redistribution when uncertainty takes the form of random output shocks. The model developed in Bucovetsky (1993) examines regions' decisions to separate, federate or merge to form a unitary state in the presence of uncertainty and risk aversion. Bucovetsky's approach is similar to the veil of ignorance approach in that constitutional decisions are made before the uncertainty is resolved in the model.

Barbosa and Jovanovic (1991) consider a constitution between two regions or countries that determines the output share for each regions when output is stochastic. In this model, there is no interregional migration or public goods. The essence of the problem is illustrated in figure II.2. If no constitution is adopted, the two region outcome, the non-cooperative outcome, is assumed to be characterized by wasteful expenditures on warfare,

Figure II.2



rent-seeking activities or trade restrictions. With cooperation, these wasteful expenditures can be avoided and the utility frontier is pushed out. This is illustrated in figure II.2 as a shift in the utility locus from U_1U_2 to $U_1'U_2'$. The non-cooperative outcome is illustrated by N. Suppose that, without warfare, the direct production point, Y, represents the natural outcome in the absence of any constitution. Since Y lies outside the set of Pareto improving allocations, the cooperative outcome can be achieved only if it involves some redistribution from region 1 to region 2, denoted as θ in Barbosa and Jovanovic's model.

Formally, Barbosa and Jovanovic assume output in each region evolves according to a first order autoregressive process and is subject to random shocks. In addition, the cost of war effort or other non-cooperative behaviour is assumed to vary according to a random shock. Total output for the two regions combined is reduced in the non-cooperative equilibrium by the costs of warfare. A representative constitutional designer is assumed to choose the fixed output shares for each region from behind a veil of ignorance (as if the designer's "position" in the economy or country of residence is unknown). Output shares or the redistribution from one region to the other is chosen to maximize expected long run output or, equivalently, to minimize the probability of non-cooperation. This approach assumes that the designer has an equal chance of being in either position. Thus, the constitution specifies cooperation so that no wasteful expenditures on warfare need to be incurred and the extent of redistribution between regions. In this case, the optimal constitution corresponds to an efficient use of resources.

Since output and costs are stochastic, the constitution does not eliminate the possibility that, at some point in time, regions might defect. Both an decrease in the costs of non-cooperative activity and an increase in the variability of shocks are potentially destabilizing forces. In addition, constitutions between regions that are more equal are easier to sustain than a constitution between regions with greater differences in rent-seeking abilities or warfare skills. This model concludes that redistribution specified in a constitution when income fluctuates can eliminate wasteful rent-seeking behaviour that would occur in the absence of such a constitution. The model also demonstrates that sufficient income fluctuation can lead to a breakdown of the constitution, a reversion to the non-cooperative outcome, and potential political instability (shifting from cooperative to wartime conditions). Barbosa and Jovanovic show that it is the rich region that is more likely to defect in an effort to keep a larger share of output. This contrasts to the instability of equilibrium result in the majority voting literature where it is the poor chasing the rich in search of greater redistribution in their favour that gives rise to instability. A result similar to Barbosa and Jovanovic's is found in Bucovetsky (1993).

Bucovetsky (1993) introduces uncertainty into a two region model with migration and no public goods. In choosing whether to merge, federate or remain separate, regions are in effect determining whether or not to allocate control over immigration to a unitary, federal or regional government. Like Barbosa and Jovanovic (1991), this constitutional decision determines whether or not income is shared across regions and how it is shared. Constitutional decisions require unanimous support of both regions.

At the time of constitutional decision-making, regions know with certainty that one region will have income equal to y^R and the other region will have income, y^P, where $y^R > y^P$. Regions, however, know only the probability, π $(1-\pi)$, that region 1 (2) becomes the rich (poor) region. Bucovetsky assumes that $\pi \geq 0.5$. Since there is no aggregate uncertainty in this model, there is no market failure in the private insurance market.[24]. Bucovetsky must therefore adopt the assumption that private insurance is unavailable to investigate regions' incentives to merge, federate or separate.

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[24] Bucovetsky argues that the lack of private insurance markets offering insurance against regional income shocks could perhaps be explained by the difficulty associated with ascertaining the true state of a region's economy. However, Bucovetsky further argues that such insurance should, in theory, be possible. This contrasts to the argument made in Boadway (1992) who argues that a market failure exists in the private insurance market since individuals who are unlucky at birth not only lack sufficient capital to purchase such insurance but that typically such

Regions are comprised of identical individuals with the same concave utility function, U(y). In a unitary state, regional incomes are pooled and shared equally among all individuals in the state. In addition, individuals are free to move to any region. A federalist state is defined as each region having exclusive control over its income (which is assumed to be shared equally among all its residents) but no control over immigration. Therefore, individuals are free to move to any region. In a separatist state, regions have exclusive control over the region's income and immigration.

Since region 2 is more likely to be poor, these residents prefer a unitary state, where each individual receives $U_2^U(\bar{y})$ where $\bar{y}$ equals $(y^R+y^P)/2$, to separation which yields utility:

$$U_2^S = (1-\pi)U(y^R) + \pi U(y^P) \quad .$$

The subscript indicates the region of residence and the superscripts, U and S, denote a unitary or separatist state respectively. Region 1 prefers a unitary state to separation only if its residents are very risk averse or the difference between y^R and y^P is small. Since unanimous agreement is required, a unitary state is adopted only if the residents of region 1 are very risk averse or if regional disparities are large.

In a federalist state, regions do not control immigration. In the absence of

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insurance must be purchased before the state of the world is known.

migration costs, individuals move until regional per capita income is the same in both regions, or individuals receive $\bar{y}$ regardless of their region of residence. This outcome is identical to the unitary state. Hence, some migration costs are necessary for a federalist state to represent a meaningful alternative. Bucovetsky finds that the distribution of population in the migration equilibrium given a federalist arrangement depends on the size of the migration cost (assumed to be identical for all individuals) and the degree of regional income disparity, y^R/y^P. The necessary condition for region 1 to prefer a federalist state to separation is a high degree of risk aversion or a coefficient of relative risk aversion greater than one.

Since all migration is costly and wasteful in his model, Bucovetsky considers the possibility of a federalist state with equalization or interregional transfers. Symmetric voluntary transfers, the magnitude of which are decided after the uncertainty is resolved but before migration occurs, are considered first. Here, the best transfer is just large enough to eliminate all migration. The ability to make such ex-post transfers makes federation a more attractive option to region 1 since they can reduce the income they must share with the other region by making transfers. Bucovetsky also considers ex-ante transfers which must be decided upon before the uncertainty is resolved. In this case, it is possible that regions agree to excessive transfers (i.e. transfers that exceed the transfer just necessary to stop all migration). Region 2 prefers larger transfers since it is more likely to be the poor region and larger transfers work to increase their expected income. The residents of region 1 may also prefer larger transfers if they are very risk averse and wish to reduce the risk associated with being the poor state. While regions agree to such excessive transfers ex-ante, the rich region has an incentive to renege on the deal ex-post. Therefore, a central authority is required to administer the transfers in this case. Bucovetsky also briefly considers the possibility of asymmetric transfers. Asymmetric transfers tend to make the federalist arrangement more attractive to region 1 who has veto power.

Bucovetsky concludes that federalism serves as a form of insurance against ex-ante differences among regions and that voluntary transfers are likely to be part of a federalist design. The necessary conditions for a federalist state to be chosen over separation or merger are large interregional differences in income, a high degree of relative risk aversion, and significant mobility costs. Bucovetsky argues that while plausible these conditions do not appear to fit with most federal states since empirically regional income disparities are not extreme, regional income shocks do not appear to be highly negatively correlated, and significant migration costs between culturally similar regions are implausible. While these observations are not without merit, Bucovetsky fails to consider how the results of his model might be affected by allowing regional income to be endogenous, by introducing local public goods, or by introducing a majority voting rule for regional decision-making. The model developed in chapter V of this thesis incorporates many of these considerations to examine what type of interregional transfers might be adopted as a form of insurance against uncertain income.

Summary

The literature on constitutional design focuses on questions of the optimal assignment of functions and responsibilities to different government levels. Much of this literature examines constitutional design using traditional public finance arguments such as diversity of preferences, externalities or spillovers. While this approach offers a valuable partial equilibrium type analysis, two important factors, risk aversion and uncertainty, are often overlooked. The contractarian approach to constitutional design, however, focuses on the importance of these two issues in constitutional design. Most recently, risk aversion and uncertainty are incorporated into theoretical models to examine the type of redistribution that would be specified in a constitution or the type of government structure (and the resulting distribution of the economy's output) to emerge.

This thesis contributes to these more recent developments by examining what type of interregional transfers or income sharing arrangements would be chosen given that regional fiscal decisions are determined by majority voting. The model developed in chapter V is richer in structure in that it allows for intraregional diversity, endogenous regional income, and local public goods. In contrast to both Barbosa and Jovanovic (1991) and Bucovetsky (1993), the choice of constitutional arrangement in this model affects not only the distribution of total output but also the total output available to be distributed. In addition, several types of income sharing arrangements are considered.

II.4. Conclusions

The review presented above summarizes the fiscal externality literature, majority voting models and the literature on optimal constitutional design. New developments in each area are highlighted and gaps in the existing literature are identified. In addition, the contribution of this thesis to each area is noted.

The fiscal externality literature examines local public goods provision in a regional model and focuses on the efficiency properties of the migration equilibrium. In doing so, two assumptions are commonly adopted: regional homogeneity and the exogeneity of a central authority. While these assumptions simplify the analysis in these models, they limit the usefulness of such models in answering questions concerning interregional transfers in federal systems. In particular, fiscal externality models fail to explain why regions participate in centrally-coerced transfers. The exogeneity of a central authority overlooks the presence of different orders of government each with its own powers and responsibilities that characterizes most federal systems. The assumption of regional homogeneity ignores intraregional diversity, another important characteristic of regions within federal systems.

This thesis addresses both these concerns. Intraregional diversity is introduced and, as a result, a collective choice rule for determining regional fiscal packages and reconciling this diversity is required. In this thesis, a majority voting rule is adopted and the effect of majority voting on public goods provision, the migration equilibrium and the social optimal in a fiscal externality context are examined. In addition, rather than assume an exogenous federal or central authority exists, the thesis examines how such a federal structure might emerge endogenously within a fiscal externality model. By introducing uncertainty, the thesis examines whether an interregional transfer scheme specifying the role and responsibility of a federal authority would be adopted before the uncertainty is resolved. By doing so, the model developed here avoids the inconsistency of assuming an exogenous federal government and highlights possible constraints on the federal government that might arise within such a model.

This research also extends the majority voting literature. Majority voting models focus on local public goods provision in a framework with interregional migration and intraregional diversity where individual income is assumed to be exogenous. The model developed in chapters III and IV introduces majority voting and examines regional public goods provision in a model with migration but where individual income is endogenous. As such, this research provides a link between the majority voting and fiscal externality literatures. With the introduction of uncertainty and a constitutional choice framework, this research also provides a link to the literature on constitutional design and the contractarian models which focus on the effects of uncertainty on constitutional design. This literature is also extended in that the effects of uncertainty are considered in a model which includes local public goods, migration and endogenous regional income. The most recent developments in this literature do not include local public goods or endogenous income and do not permit intraregional diversity as is done in the model presented in chapter V.

Chapter III. Regional Model With Majority Voting and Diverse Preferences

Earlier models in the fiscal externality literature have demonstrated the importance of the myopia assumption when regional authorities choose the level of the public good to maximize the utility of some representative resident. As demonstrated in chapter II, in this literature, decentralized decision-making at the regional level leads to fiscal differences across regions. Mobile individuals may move in response to these differences rather than move to the region where their social marginal product is highest, as efficiency dictates. Early work concludes that the migration equilibrium fails to achieve the socially optimally distribution of population.

Subsequent developments extend the literature to examine whether this result is driven by the assumption that regional governments are myopic or lack the necessary fiscal instruments to achieve the optimum as a decentralized migration equilibrium. For example, Boadway (1982) shows that myopic behaviour distorts public goods provision relative the social optimum under property tax financing in a model with identical individuals. If regional authorities are non-myopic and aware of the migration effects of their fiscal decisions, the optimal level of provision is, however, restored. If direct taxes are used to finance public expenditures, assumptions regarding myopia leave the provision rule unchanged from the optimal Samuelson condition.

Adopting the non-myopic behaviourial assumption, Myers (1990) examines regional incentives to make voluntary transfers in a model with identical individuals and whether these transfers eliminate the need for centrally-coerced transfers. Myers shows that the optimum can be obtained as a decentralized migration equilibrium and no coerced transfers are required if regional governments are non-myopic. Although the myopic case is not explored in Myers' model, the results for this case are straightforward. If individuals are myopic, Myers' model collapses to the simple model presented in Boadway and Flatters (1982) and myopic governments have no incentive to make regional transfers voluntarily. If head taxes are the only available revenue source, public goods provision is optimal, satisfying the Samuelson condition in both regions. Others find that while non-myopic regional governments may voluntarily make interregional transfers, in general, these transfers are insufficient to ensure a socially optimal distribution of labour when mobility is costly or when individuals differ in some respect.

In the fiscal externality literature, regions are often assumed to be homogeneous, ignoring the issue of diverse preferences within a region and the effect of this diversity on regional decision-making and public goods provision. As a result, government decision-making is modelled in a simplistic manner. Regional governments choose the fiscal package to maximize the utility of a representative individual, and by doing so, maximize the utility of all residents. While the majority voting literature studies the effect of diverse preferences on local public goods provision, individual income is assumed to be location-independent. Thus, we are removed from the fiscal externality world.

This chapter examines the effect of myopia on local public goods provision when regional fiscal decisions are determined by majority voting. The model developed in this chapter extends the fiscal externality literature by introducing diverse preferences for the fiscal package within a region to examine regional public goods provision under alternative assumptions regarding individual, and regional government, myopia. With diverse intraregional preferences, it is necessary to specify a collective choice mechanism to reconcile this diversity and to guide regional fiscal decision-making. A simple majority voting mechanism is adopted in this model. The model also links the fiscal externality literature, where income is endogenous and individuals are mobile, to the majority voting literature, where public goods provision is examined in the presence of individual mobility and fixed income. In addition, this model forms the basic building block for the extensions considered in subsequent chapters.

In section III.1, the basic structure of the model is developed. Regional production technology is specified and individual types are defined in terms of labour endowments and mobility costs. As a useful benchmark, the optimal level of public goods provision is derived from the planner's problem and compared to public goods provision under majority voting in section III.2 for the case of no mobility. Since individuals are immobile, no assumption regarding individual myopia is required. Mobility is introduced in section III.3 and the social optimum and the majority decision rules under alternative myopia assumptions are derived. Here, myopic and non-myopic public goods provision under majority voting is compared to the socially optimal level of public good. In section III.4, myopic and non-myopic public goods provision are examined in detail. The migration equilibrium under the alternative myopia assumptions are characterized and several propositions, derived from the model, are discussed. A numerical example is presented in section III.5 and conclusions are offered in the final section.

III.1. Two Region Framework

The model adopts the two region fiscal externality framework and maintains the assumption of a perfectly inelastic supply of individual labour endowments, normalized to one. Individual mobility costs are assumed to be asymmetric, resulting in perfect mobility for type A labour and perfect immobility for type B labour. While this asymmetry is extreme, differences in mobility costs do exist and one can think of regions where there exists a sizeable immobile population (i.e. the Atlantic region or Quebec, for example). The total supplies of types A and B labour in the national economy (the sum of that in both regions) are fixed at L^A and L^B respectively and individuals are unable to influence their labour type. The national population constraints for the economy are:

$$L^{A} = L_1^{A} + L_2^{A} \quad , \tag{III.1.1}$$

and

$$\begin{aligned} L_i^{B} &= \overline{L_i^{B}}, \quad \textit{for} \ \ i = \{1, 2\} \ , \\ \textit{and} \quad \overline{L_1^{B}} + \overline{L_2^{B}} &= L^{B} \quad . \end{aligned} \tag{III.1.2}$$

For convenience, the overline denoting type B's immobility is dropped in all subsequent notation.

Each labour type enters as a separate input in the production of a traded good, y_i, where i indexes the region of production and employment. The production function for y_i exhibits constant returns to scale technology in all inputs and is given below as :

$$y_i = F(L_i^A,\ L_i^B,\ T_i), \qquad where \quad F_i^k = \frac{\partial y_i}{\partial k} > 0,$$

$$\text{(III.2)} \qquad F_i^{kk} = \frac{\partial F_i^k}{\partial k} < 0,$$

$$k = \{L_i^A, L_i^B,\ and\ T_i\}\ .$$

L_i^A, L_i^B and T_i represent region i's type A labour input and fixed endowments of type B labour and land respectively. The marginal product of input k in region i, F_i^k, is assumed to be diminishing. Interactive effects between labour types are ruled out so that a change in any one type of labour leaves the marginal product of another labour type unaffected and, to ensure constant returns to scale, complementarity between land and labour is assumed.[25] Regional production is governed by perfect

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[25] In essence, these assumptions combine to yield a production function with the following form:

$$y_i = \left(T_i^A\right)^{\alpha}\left(L_i^A\right)^{(1-\alpha)} + \left(T_i - T_i^A\right)^{\beta}\left(L_i^B\right)^{(1-\beta)} \ .$$

Output is, in effect, the sum of output produced from two separate CRS production functions. Alternatively, adopting a Cobb-Douglas production function of the form, competition and profit maximizing behaviour. Thus, individuals are paid according to their marginal product, F^h_i.

Income of a type h individual in region i consists of wage earnings and an equal share of the region's rents, R_i, and is given as[26]:

$$z_i^h = F_i^h + \frac{R_i}{(L_i^A + L_i^B)}, \tag{III.3}$$

where

$$R_i = F(L_i^A, L_i^B, T_i) - F_i^A L_i^A - F_i^B L_i^B, \quad i = \{1, 2\} \text{ and } h = \{A, B\} \tag{III.4}$$

Regional rent sharing is equivalent to assuming that land is owned by the regional authority and rents are shared on an equal per capita basis. The Alaska Permanent Fund and the Alberta Heritage Savings Trust Fund are examples where regional rents

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$(T)^\alpha(L^A)^\beta(L^B)^\gamma$, where $\alpha+\beta+\gamma=1$, allows for interactive effects between type A and B labour as well as land and labour complementarity. The myopic and non-myopic majority decision rules for public goods provision derived with this more generalized production technology are qualitatively the same as those derived in this chapter. Hence, propositions 1 and 2 generalize to the case where interactive effects between labour types in production are permitted. Interactive effects are briefly considered in appendix A.

[26] This particular assumption in fact gives rise to four labour types as defined by both mobility and rent ownership. The assumption of public land ownership and regional rent sharing is used in early fiscal externality models like Boadway and Flatters (1982). The results of this chapter, however, generalize to other land ownership structures. Under the assumption of national ownership, adopted in Myers (1990) and Burbidge and Myers (1994), each individual owns an equal share of the economy's land and receives an equal share of total rents. Myopic and non-myopic decision rules derived under this ownership structure are not qualitatively different from those derived in this chapter. In addition, propositions 1 and 2 hold if mobile individuals are assumed to have sole ownership of land.

are partly shared on a residency basis. With migration, individual's entitlements to these rents change.

Individual preferences, defined over a private consumption good, x_i^h, and a pure local public good, G_i, are represented by the utility function[27]:

$$U(x_i^h, G_i), \quad for \quad i = \{1, 2\} \quad and \quad h = \{A, B\} \quad , \tag{III.5}$$

which is strictly quasi-concave and continuous in both its arguments. ${}_iU_j^h$ represents the marginal utility derived by a type h individual in region i from a change in the jth argument of the utility function where $j=\{x, G\}$. For example, ${}_1U_G^A$ is the marginal utility of the public good for a type A individual in region 1. Similarly, ${}_iU_{js}^h$ represents the partial derivative of ${}_iU_j^h$ with respect to the sth argument of the utility function where $j=\{x, G\}$ and $s=\{x, G\}$. Consumption of the private good for a type h resident of region i is:

$$x_i^h = z_i^h - \tau_i , \tag{III.6}$$

where τ_i is the uniform head tax levied in region i to finance public expenditures.[28]

Individual Decision-making

Individuals have at most two choices to make. Type A individuals must choose their region of residence and, given this, must choose their desired fiscal package, (G_i, τ_i). Type B individuals have only one choice: to determine their desired fiscal package. Implicit in this formulation is the assumption that individuals are well-informed and non-myopic regarding the budget constraint facing the majority coalition or government. Each individual's preferred fiscal package depends, however, on whether individuals are myopic with respect to the migration effects of their fiscal choices or whether they take the equal utilities condition:

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[27] The model could easily be extended to include congestion.

[28] In Burbidge and Myers (1994), other tax and transfer instruments are considered to allow for voluntary interregional transfers. The incentives for voluntary transfers in this model are examined in chapter IV where explicit intraregional and interregional transfers, financed by a uniform head tax, are introduced.

$$U(x_1^A, G_1) = U(x_2^A, G_2) \quad , \tag{III.7}$$

into consideration when choosing their desired fiscal package. The labour type to form the majority in the region then chooses the preferred fiscal package of a representative individual of the majority type, or equivalently, chooses the fiscal package to maximize the utility of a representative from the majority.

Regional Decision-making

While individual preferences for the public good are described by the same utility function, individuals' incomes may differ and this gives rise to diverse demands for the fiscal package within a region if the income elasticity of demand for the public good is not zero. Hence, a collective decision rule is required to reconcile this intraregional diversity in preferences. The labour type that represents a simple majority in a region forms the regional government and determines government expenditures. This contrasts to the standard assumption adopted in the fiscal externality models that regional governments maximize the utility of a representative individual and, since individuals are identical, maximize the utility of all individuals in the region. Boadway and Flatters (1982), Myers (1990) and Mansoorian and Myers (1993) all adopt this approach. In Burbidge and Myers (1994) individuals differ and each regional government is assumed to have an exogenous social welfare function that determines the region's preferences for redistribution.

Regional majorities are assumed to maximize the utility of a representative individual from the majority coalition (type t) by choosing the level of public good and type t's private good consumption. Each majority is constrained, however, to finance expenditures with a uniform head tax and to balance its budget. The budget constraint for region i is

$$G_i = \tau_i(L_i^A + L_i^B) \quad . \tag{III.8}$$

The choice of G_i and τ_i must also satisfy the regional feasibility condition,

$$y_i = L_i^A x_i^A + L_i^B x_i^B + G_i \quad . \tag{III.9}$$

With head taxes, each individual contributes equally to the financing of the majority-determined public expenditures. As a result, the minority can be exploited through the majority's choice of public good. Under an alternative financing regime, like proportional income taxation, the majority can shift a larger share of the tax burden to individuals in the minority, if minority income exceeds majority income. Since the results regarding myopia are, however, the same under proportional income taxation, little is gained by adopting a more sophisticated tax structure.

It is useful to first characterize the optimum and the migration equilibrium when all individuals are immobile. This is done in section III.2. Following this, public goods provision is reexamined in section III.3 for the case when type A individuals are perfectly mobile.

III.2 Regional Public Goods Provision With Immobile Individuals

The analysis begins by deriving the optimal rule for public goods provision with uniform taxation when individuals are immobile. Following this, the rule for public goods provision is determined for the case where regional fiscal decisions are determined by majority voting. The socially optimum level of public goods provision is then compared to provision under majority voting. When individuals are immobile, there is no need to distinguish between myopic and non-myopic behaviour. In other words, the regional majority fiscal decisions are invariant to myopia assumptions.

Social Optimum

As a useful benchmark for purposes of comparison, the optimal rule for public goods provision given uniform head tax financing is derived for the existing distribution of income. An allocation is socially optimal if there is no possible reallocation of resources that could increase the welfare of one individual without making someone else worse off. Formally, the social planner chooses x_i^A, x_i^B and G_i

to maximize the following objective function[29]:

$$L = U(x_i^A,\, G_i) + \lambda\left[\, U(x_i^B, G_i) - \overline{U(x_i^B, G_i)}\,\right] + \mu\left[\, y_i - x_i^A L_i^A - x_i^B L_i^B - G_i \,\right] \quad .$$

The first order conditions to this problem are:

$$\text{(III.10)} \qquad \frac{\partial L}{\partial x_i^A} = {}_iU_x^A - \mu L_i^A = 0 \quad ,$$

$$\text{(III.11)} \qquad \frac{\partial L}{\partial x_i^B} = \lambda\, {}_iU_x^B - \mu L_i^B = 0 \quad ,$$

$$\text{(III.12)} \qquad \frac{\partial L}{\partial G_i} = {}_iU_G^A + \lambda\, {}_iU_G^B - \mu = 0 \quad .$$

Substituting equations (III.10) and (III.11) into equation (III.12) yields the modified Samuelson condition:

$$\text{(III.13)} \qquad \left(\frac{{}_iU_G^A}{{}_iU_x^A}\right)\frac{L_i^A}{L_i^A + L_i^B} + \left(\frac{{}_iU_G^B}{{}_iU_x^B}\right)\frac{L_i^B}{L_i^A + L_i^B} = \frac{1}{L_i^A + L_i^B} \quad ,$$

---

[29] Labour immobility in this cases fixes output so it is not a choice variable for the planner.

where the level of the public good is increased until the weighted sum of the individual marginal rates of substitution just equals the marginal cost of expansion or the unit price.

Public Goods Provision With Majority Voting

The individual type that forms the majority in the region chooses the region's fiscal package to maximize the utility of a representative individual from the majority. Formally, a type t majority in region i chooses private goods consumption for a type t individual and the public good to maximize:

$$L = U(x_i^t, G_i) + \lambda_1\left(x_i^t - F_i^t - \frac{R_i}{L_i^A + L_i^B} + \tau_i\right) + \lambda_2\left(\tau_i - \frac{G_i}{L_i^A + L_i^B}\right),$$

taking into account the equations of model described in section III.1 and the additional constraint that the regional type A population is fixed. Using the government budget constraint, x_i^t can be written as a function of G_i. Thus, the majority simply chooses G_i to satisfy the following first order condition:

$$\text{(III.14)} \qquad {}_iU_G^t + {}_iU_x^t\left(\frac{\partial x_i^t}{\partial G_i}\right) = 0 \quad \textit{where} \quad t \in \{A, B\} \quad \textit{and} \quad i = \{1, 2\}.$$

The sufficient second order condition is:

$$\text{(III.15)} \qquad {}_iU_{GG}^t - 2\frac{{}_iU_{Gx}^t}{(L_i^A + L_i^B)} + \frac{{}_iU_{xx}^t}{(L_i^A + L_i^B)^2} < 0 .$$

Solving for $\partial x_i^t/\partial G_i$ using equations (III.3), (III.6) and the government budget constraint, given by equation (III.8), and substituting the result into equation (III.14) yields the following decision rule for the type t majority in region i:

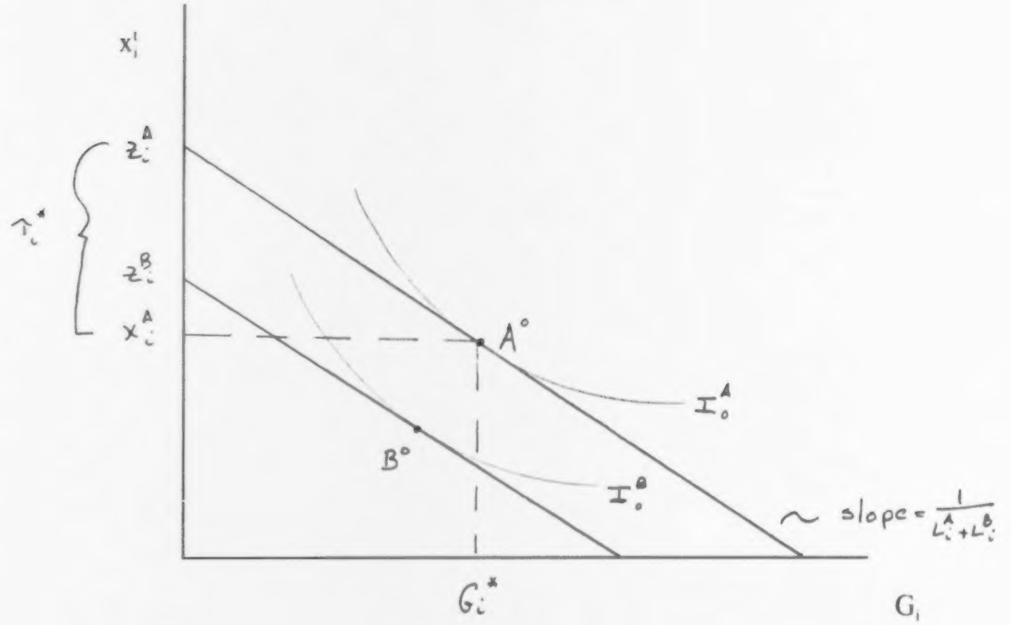
$$\text{(III.14}'\text{)} \qquad \frac{{}_iU_G^t}{{}_iU_x^t} = \frac{1}{(L_i^A + L_i^B)} .$$

Equation (III.14′) states that the type t majority in region i chooses the level of the public good such that the marginal benefit from an additional unit of the good (valued in terms of the numeraire, x_i^t) just equals its marginal cost, or the unit price to a type t individual. The unit price of the public good is simply 1/n where n equals the total population for the region. This price reflects the fiscal externality arising from cost sharing of a pure public good.

Given the model's assumptions regarding preferences and assuming that regional populations are fixed, equation (III.14′) represents a unique choice for the fiscal package. In figure III.1, A° and B° represent the preferred fiscal packages for a type A and a type B individual in region i when L_i^A and L_i^B are such that type A individuals form the majority. Both individuals face a budget constraint with slope equal to $1/(L_i^A+L_i^B)$, but incomes, as measured on the vertical axis, can differ. As drawn, the marginal product of a representative type A individual is greater than the marginal product of a type B individual. Assuming a positive income elasticity of demand for the public good, the preferred fiscal package for a type A individual has more of the public good relative to the package preferred by a type B individual.

Given that $L_i^A > L_i^B$, the type A majority in region i chooses G_i^*, financed with a per person tax equal to τ_i^* or $G_i^*/(L_i^A+L_i^B)$. Unless type A and B individuals have identical incomes, the preferences of the minority type are not satisfied when the fiscal package is chosen by majority voting. This implies a reduction in utility when compared to the level of utility achieved when this individual's optimal choice of fiscal package is the one chosen for the region.

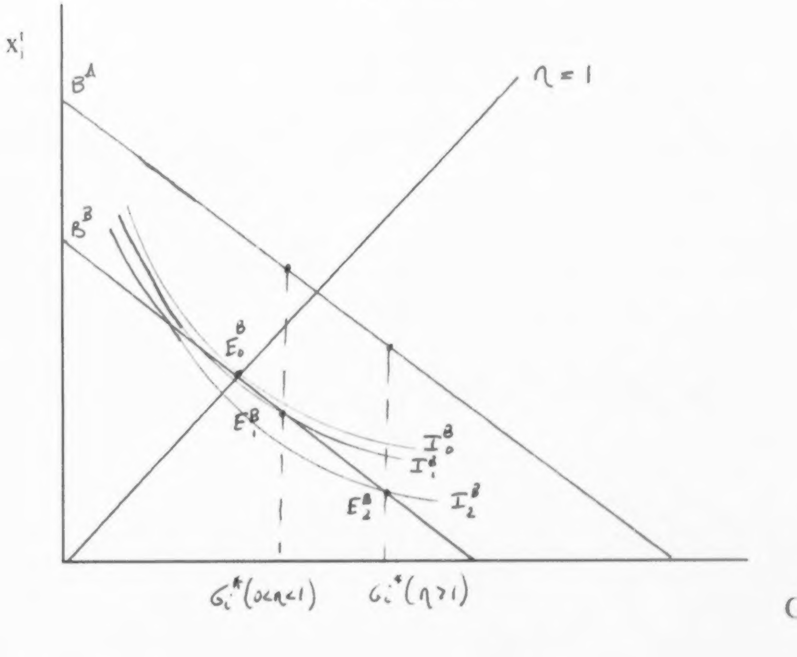
Figure III.1



Both the size of the relative wage differential and the income elasticity of demand for the public good affect the extent to which the preferred fiscal packages of the minority and majority type differ. For example, for a given wage differential, the larger is the income elasticity of demand for the public good, the farther away is the majority's choice of fiscal package from the preferred choice of individuals in the minority, and the worse off a minority individual is relative to the situation where a minority individual obtains their optimal choice. Figure III.2 illustrates this point.

Suppose a type A majority exists in region i and the income elasticity of demand for the public good is positive but less than one. The optimal (and actual) fiscal package in region i as determined by type A preferences is denoted as $G_i^*(0<\eta<1)$ in figure III.2. Given type A's preferred fiscal package, a type B individual consumes at E_1^B and receives utility given by the indifference curve, I_1^B. If type B preferences are satisfied exactly, or if type B individuals choose the fiscal

Figure III.2



package, then this individual consumes at E_0^B and receives the higher level of utility given by I_0^B. Suppose the income elasticity of demand for the public good is greater than one. For a given income differential, the level of public good preferred by type A individuals, $G_i^*(\eta > 1)$, is greater than the level of public good preferred by a type B individual. The type B individual consumes at E_2^B and receives utility I_2^B. Since the majority's choice of fiscal package is further away from the preferred choice of the type B individual, the minority individual's utility is lower relative to the case where the income elasticity is smaller.[30]

Is Public Goods Provision Under Majority Voting Optimal?

A comparison of equation (III.13) and (III.14′) demonstrates that regional public goods provision with majority voting differs from the optimum unless type A and type B individuals have identical incomes or preferences are quasi-linear.[31] In general, the weighting of the individual marginal rates of substitution, or marginal benefits, in equation (III.13) implies that the optimal level of public goods provision lies somewhere in the range between the preferred choices of the two individual types. In contrast, under a majority voting rule, the level of public goods provision can be either larger or smaller than the level given by the modified Samuelson rule. Note that imposing the assumption of uniform taxation, individuals may not pay a price equal to the their marginal benefit in the optimum or majority voting equilibrium.

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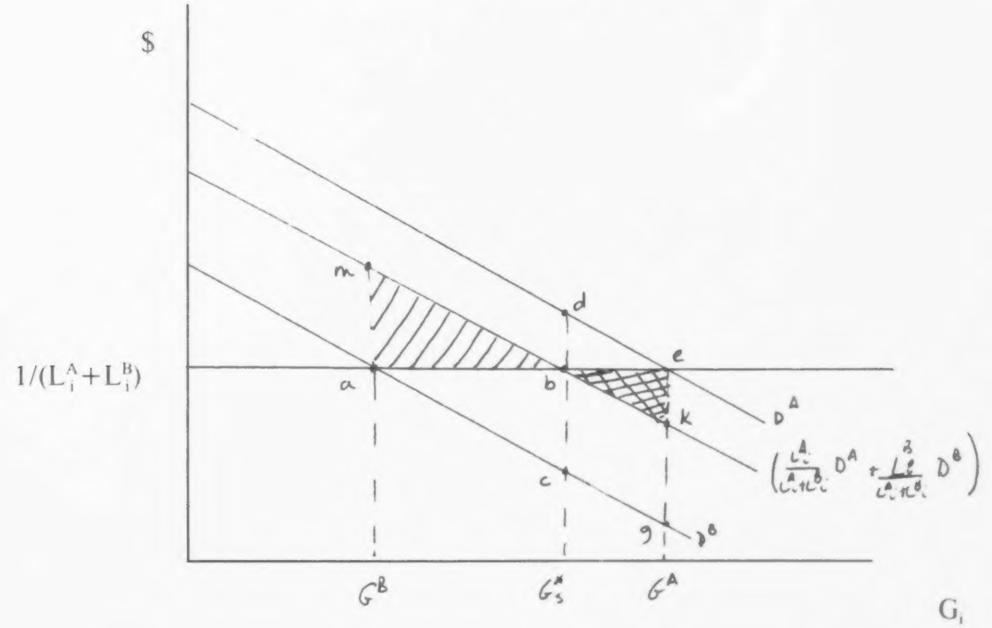
[30] If the income elasticity of demand for the public good is equal to zero then the choice of G (and the tax rate, τ,) is independent of an individual's labour endowment and no utility loss is suffered from being a member of the minority coalition. This would be the case if the utility function was quasi-linear.

[31] Note that Bergstrom (1979) shows that public goods provision is optimal if the distribution of tastes are uncorrelated with wealth. In this model, differences in tastes for the fiscal packages are determined by differences in wealth so it is unlikely that the Bergstrom optimality result would carry over.

In figure III.1 majority voting results in too much public good from the point of view of a type B individual in the minority. Figure III.3 shows how the modified Samuelson level G_s^*, given by equation (III.14′), might differ from a type A majority's choice, G^A, when the marginal product (and income) of a type A exceeds the marginal product (and income) of a type B individual and the income elasticity of demand for the public good is greater than zero. D^A and D^B represent the demand

Figure III.3



curves for the public good for a type A and a type B individual respectively. When type A (type B) individuals form the majority, public good output increases (decreases) from G_s^* to $G^A(G^B)$. Associated with this non-optimal level of public goods provision, is a welfare loss equal to area bek for the case where mobile individuals form the majority and area abm for the case where the immobile individuals form the majority.

The above discussion demonstrates that the majority's choice of public good given uniform head taxes differs from the optimal level of provision as determined by the modified Samuelson condition when no interregional mobility is permitted. In section III.3 below, costless mobility for type A individuals is introduced and the socially optimal level of public goods provision is reexamined and compared to public goods provision with majority voting.

III.3 Public Goods Provision With Mobile Type A Individuals

In this section, the socially optimal level of public goods provision and distribution of population when type A labour is perfectly mobile are derived. Following this, decision rules for public goods provision are derived under alternative assumptions regarding individual myopia. With migration, the location decisions of mobile individuals can be influenced by regional fiscal choices. Depending on whether regional majorities incorporate these effects into their decision-making, the conditions for public goods provision with majority voting may be sensitive to assumptions regarding individual, and regional government, myopia.

Note that the welfare loss associated with majority voting discussed above is also present once mobility is introduced, although the magnitude of the distortion may, however, differ. For example, suppose the marginal benefit schedules depicted in figure III.3 describe region i in a world with no migration and assume a type A majority in region i. Relative to the Samuelson level, the level of the public good is too high. With the introduction of type A mobility, suppose region i sees an increase in its type A population. This in-migration reduces the unit price of the public good and shifts the marginal benefit curves for both types of individuals in the region as a result of income changes. Thus, in-migration leads to a change in the optimal level of public good provided in the region and in the size of the welfare loss triangles shown in figure III.3. General conclusions about whether the welfare losses associated with majority voting and type A mobility are greater or less than the case with no mobility are, however, difficult to make.

The introduction of mobility also gives rise to other important considerations. As type A individuals migrate from one region to another, the marginal product, and therefore the wage, of type A workers in both regions is affected. In addition, migration affects the total rents generated in each region and the per capita rent share accruing to each resident. Since land and labour are complements in production, total rents in a region increase with in-migration. The number of individuals with a claim on these rents also increases so the net effect on per capita rents is ambiguous, all else constant.[32] This rent-sharing externality is discussed in Boadway and Flatters (1982). The "fiscal externality" effect of migration discussed in Boadway and Flatters is also present in this model. The addition of one more individual to a region's population lowers the tax that must be paid by all existing residents. Since individuals do not generally take into account these effects when choosing their region of residence, it is unlikely that the migration equilibrium is socially optimal.

The migration of type A labour may be sufficient to change the identity of the majority in either region. This switching problem can lead to instability in the migration equilibrium. Ideally, regional majorities would be determined endogenously within the model. To examine majority switching in a model with local public goods provision and migration requires, at the very least, a move away from the static model developed here and lies beyond the scope of this paper. There exists an abundance of interesting questions and problems related to majority switching and future research in this direction would be valuable indeed.

Social Optimum

To determine an optimal allocation, the planner chooses x_i^A, x_j^A, x_i^B, x_j^B, G_i, G_j

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[32] The net effect on per capita rents from a change in region i's type A population is

$$\frac{\partial\left(\dfrac{R_i}{L_i^A+L_i^B}\right)}{\partial L_i^A} = \frac{-F_i^{AA}L_i^A}{(L_i^A+L_i^B)} - \frac{R_i}{(L_i^A+L_i^B)^2} .$$

Since both terms are positive, the overall effect is ambiguous.

and L_i^A to maximize the objective function given below[33]:

$$
\begin{aligned}
L = U(x_i^A, G_i) &+ \lambda\left[U(x_j^A, G_j) - \overline{U(x_j^A, G_j)}\right] \\
&+ \mu_1\left[U(x_i^B, G_i) - \overline{U(x_i^B, G_i)}\right] \\
&+ \mu_2\left[U(x_j^B, G_j) - \overline{U(x_j^B, G_j)}\right] \\
&+ \psi\,[F(L_i^A, L_i^B, T_i) + F(L^A - L_i^A, L_j^B, T_j) \\
&- x_i^A L_i^A - x_j(L^A - L_i^A) - x_i^B L_i^B - x_j^B L_j^B - G_i - G_j],
\end{aligned}
$$

where the overline indicates that the utilities of type A individuals in region j and of all type B individuals must equal some specified level. The first order conditions to this problem are:

(III.16) $$\frac{\partial L}{\partial x_i^A} = {}_iU_x^A - \psi L_i^A = 0 \quad ,$$

---

[33] This specification does not constrain the planner to an allocation where type A individuals in the two regions must have equal utility. This is the approach used in Myers (1990), who argues that finding a Pareto optimal allocation compatible with a free migration equilibrium introduces private decision-making into the optimality problem. Boadway (1982) and Burbidge and Myers (1992) derive the optimality conditions for the case when the planner is constrained to ensure equal utilities for perfectly mobile individuals. With direct taxation, both models show these conditions to be identical to the optimality conditions when the planner is not so constrained. Thus, in this model, the planner's problem is identical to the planner's problem in Burbidge and Myers (1992) except for some differences which have little impact on the planner's problem. As a result, the optimality conditions given in equations (III.16) to (III.22) are identical whether or not free migration of type A individuals in permitted in the social optimum.

(III.17)
$$\frac{\partial L}{\partial x_j^A} = \lambda\, {}_jU_x^A - \psi L_j^A = 0 \quad ,$$

(III.18)
$$\frac{\partial L}{\partial x_i^B} = \mu_1\, {}_iU_x^B - \psi L_i^B = 0 \quad ,$$

(III.19)
$$\frac{\partial L}{\partial x_j^B} = \mu_2\, {}_jU_x^B - \psi L_j^B = 0 \quad ,$$

(III.20)
$$\frac{\partial L}{\partial G_i} = {}_iU_G^A + \mu_1\, {}_iU_G^B - \psi = 0 \quad ,$$

(III.21)
$$\frac{\partial L}{\partial G_j} = \lambda\, {}_jU_G^A + \mu_2\, {}_jU_G^B - \psi = 0 \quad ,$$

(III.22)
$$\frac{\partial L}{\partial L_i^A} = \psi\left(F_i^A - F_j^A + x_j^A - x_i^A\right) = 0 \quad .$$

Using equations (III.16), (III.18) and (III.20), a modified Samuelson condition for public goods provision in region i is obtained:

(III.23)
$$\left(\frac{{}_iU_G^A}{{}_iU_x^A}\right)\frac{L_i^A}{L_i^A + L_i^B} + \left(\frac{{}_iU_G^B}{{}_iU_x^B}\right)\frac{L_i^B}{L_i^A + L_i^B} = \frac{1}{L_i^A + L_i^B} \qquad \text{for } i = \{1,2\} \quad .$$

Note that this condition is identical to the optimal condition for public goods provision when all labour is immobile. Rearranging equation (III.22), the following condition for the optimal allocation of mobile labour is found:

$$(III.24) \qquad \left(F_i^A - x_i^A\right) = \left(F_j^A - x_j^A\right) \quad ,$$

which requires that type A labour be allocated so that the net marginal social benefit of an additional worker is equated across regions. The net marginal social benefit represents the contribution of an additional worker to regional output minus what this individual takes out of the economy as private consumption. This condition is identical to the optimal condition for the allocation of mobile labour derived in Boadway and Flatters (1982) and Myers (1990). Substitution of equations (III.6) and (III.8) into equation (III.24) shows that to achieve an optimal regional distribution of mobile labour, taxes net of rent shares, or net taxes, collected from a type A individual must be the same in both regions.[34]

Public Goods Provision, Majority Voting, and Myopic Behaviour

The analysis presented in section III.2 holds the two regional populations fixed and demonstrates the inefficiency in public goods provision given majority rule and uniform taxation. Here, public goods provision and the distribution of population in the migration equilibrium can be compared to the socially optimal level of public goods provision and the regional allocation of labour derived above. In addition, this section focuses on whether myopia matters for public goods provision and the migration equilibrium when regional fiscal decisions are made according to majority voting, public expenditures are financed with a uniform head tax, and type A individuals are perfectly mobile.

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[34] Further discussion of the optimal allocation of labour in comparison to the allocation of mobile labour in the migration equilibrium in presented in chapter IV.

Myopia with respect to the fiscal effects of migration implies that individuals, and regional majorities, act as if a region's type A population is fixed. Thus, the maximization problem facing a type t majority in region i is identical to the no mobility case. The first order condition governing the regional majority's fiscal choice is:

$$\text{(III.14)} \qquad {}_iU^t_G + {}_iU^t_x\left(\frac{\partial x^t_i}{\partial G_i}\right) = 0 \qquad \textit{where } t \in \{A, B\} \textit{ and } i = \{1, 2\} ,$$

where, using equation (III.6) and (III.8), $\partial x^t_i/\partial G_i$ equals $1/(L^A_i+L^B_i)$. The sufficient second order condition is[35]:

$$\text{(III.15)} \qquad {}_iU^t_{GG} - 2\frac{{}_iU^t_{Gx}}{(L_i^A + L_i^B)} + \frac{{}_iU^t_{xx}}{(L_i^A + L_i^B)^2} < 0 .$$

The equilibrium levels of G_1, G_2 and L^A_1 are determined by a three equation system consisting of a first order condition for each myopic regional majority and the equal utilities condition. Assuming a type t majority in region 1 and a type m majority in region 2, this system can be written as:

---

[35] Since behaviour is myopic, this second order condition need not take into account the endogeneity of L^A_i.

(III.14.1) $${}_1U_G^t - \frac{{}_1U_x^t}{(L_1^A + L_1^B)} = 0 \quad ,$$

(III.14.2) $${}_2U_G^m - \frac{{}_2U_x^m}{(L^A - L_1^A + L_2^B)} = 0 \quad ,$$

(III.7) $$U(x_1^A, G_1) = U(x_2^A, G_2) \; .$$

The equilibrium solutions for regional expenditures on public goods cannot be derived by solving this three equation system explicitly. The Jacobian determinant to this system must be non-singular to ensure the existence of a unique equilibrium.[36] For the remainder of the analysis, a unique and stable equilibrium is assumed to exist.

If regional fiscal decisions lead to interregional utility differentials for type A individuals, migration occurs. In equilibrium, regional fiscal choices, in conjunction with the allocation of mobile labour, must be consistent with the equal utilities condition, given by equation (III.7). In contrast, when individuals are immobile as is the case in section III.2, there are no interregional interdependencies and equation

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[36] Issues relating to the existence and uniqueness of equilibrium are discussed in Appendix B.

(III.7) has no role in the determination of regional public expenditures. Thus, the level of public good chosen to satisfy equation (III.14) when individuals are immobile generally differs from the myopic equilibrium level of public good given by equation (III.14) when type A individuals are mobile.

Public Goods Provision, Majority Voting and Non-Myopic Behaviour

In the next section, regional majority fiscal decision rules are derived under the assumption that individuals, and regional majorities, are non-myopic. Myopic and non-myopic regional decision rules and migration equilibria are then compared to the socially optimal provision rule. Non-myopic behaviour implies that individuals, and regional majorities, are aware that regional fiscal decisions affect each region's share of mobile labour. In this model, majorities are assumed to be Nash competitors with respect to the other region's choice of public good, a standard assumption in the fiscal externality literature.[37]

Assuming type t forms the majority in region i, the optimization problem is:

$$\underset{G_i}{\mathit{maximize}}\ L = U(x_i^t, G_i) + \lambda\left(U(x_1^A, G_1) - U(x_2^A, G_2)\right)\ \mathit{for}\ i = \{1,2\}\ \mathit{and}\ t \in \{A, B\}\ ,$$

---

[37] See footnote 14. While this assumption is common in the literature, alternatives could be explored. In the Canadian context, it is unrealistic to assume that while regional governments are aware their fiscal choices affect population, they are unaware of the interdependence between regional fiscal packages (i.e. $\partial G_i/\partial G_j = 0$). Strategic interdependence in this model represents an interesting possibility for future consideration.

subject to the relevant constraints given by equations (III.1.1), (III.1.2), (III.2) to (III.6), (III.8), and (III.9). The equal utilities condition, equation (III.7), implicitly defines L_i^A as a function of G_i and G_j. This implicit function can be substituted into the above to give an unconstrained maximization problem. The non-myopic first order condition to this unconstrained problem is:

$$\text{(III.25)} \qquad {}_iU_G^t + {}_iU_x^t\left(\frac{\partial x_i^t}{\partial G_i}\right) + {}_iU_x^t\left(\frac{\partial x_i^t}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial G_i}\right) = 0 \quad .$$

The first and second terms are the direct marginal utility and the direct marginal cost respectively of a small change in the level of public good for a type t individual in region i. From equations (III.3), (III.6) and (II.8), we see that $\partial x_i^t/\partial G_i$ equals $-1/(L_i^A+L_i^B)$ or, in other words, an increase in the level of the public good requires an increase in the head tax and lowers private good consumption. Thus, the second term captures the change in utility resulting from the change in the tax, weighted by the marginal utility of disposable income or the numeraire. In contrast to the myopic decision rule, equation (III.14), the non-myopic rule includes an additional term. This third term captures the indirect utility effect of fiscally-induced migration. A change in the public good affects the region's share of the mobile population, which, in turn, affects the disposable income of a type t individual in the region by potentially changing per capita rents, marginal productivity of type A labour and the head tax.

The perceived migration response, $\partial L_1^A/\partial G_i$, is found by totally differentiating the equal utilities condition with respect to G_i and L_1^A holding all other variables fixed.[38] Thus, the perceived migration response for regions' 1 and 2 are, respectively:

$$\text{(III.26)} \qquad \frac{dL_1^A}{dG_1} = \frac{\partial L_1^A}{\partial G_1} = \frac{-\left({}_1U_G^A - \dfrac{{}_1U_x^A}{L_1^A + L_1^B} \right)}{\left({}_1U_x^A \dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \dfrac{\partial x_2^A}{\partial L_1^A} \right)} ,$$

and

$$\text{(III.27)} \qquad \frac{dL_1^A}{dG_2} = \frac{\partial L_1^A}{\partial G_2} = \frac{\left({}_2U_G^A - \dfrac{{}_2U_x^A}{L^A - L_1^A + L_2^B} \right)}{\left({}_1U_x^A \dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \dfrac{\partial x_2^A}{\partial L_1^A} \right)} .$$

Assuming a type t and type m majority in regions' 1 and 2 respectively, each region's non-myopic decision rule is found by substituting the perceived migration response, $\partial L_1^A/\partial G_i$, into equation (III.25) and is given below as:

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[38] The methodology used here to find the perceived migration response, $\partial L_1^A/\partial G_i$, is described in Stiglitz (1977) and developed in Boadway (1982) and Myers (1990).

$$\text{(III.28)} \quad {}_1U_G^t - \frac{{}_1U_x^t}{L_1^A + L_1^B} + {}_1U_x^t \left(\frac{\partial x_1^t}{\partial L_1^A} \right) \left(\frac{-\left({}_1U_G^A - \frac{{}_1U_x^A}{L_1^A + L_1^B} \right)}{{}_1U_x^A \frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \frac{\partial x_2^A}{\partial L_1^A}} \right) = 0 \ \textit{for } t \in \{A, B\} \ ,$$

for region 1, and

$$\text{(III.29)} \quad {}_2U_G^m - \frac{{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m \left(\frac{\partial x_2^m}{\partial L_1^A} \right) \left(\frac{\left({}_2U_G^A - \frac{{}_2U_x^A}{L^A - L_1^A + L_2^B} \right)}{{}_1U_x^A \frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \frac{\partial x_2^A}{\partial L_1^A}} \right) = 0 \ \textit{for } t \in \{A, B\} \ ,$$

for region 2.

Equilibrium levels of G_1, G_2 and L_1^A are determined by the three equation system consisting of a non-myopic decision rule for each regional majority and the equal utilities condition. Using the implicit function theorem, the equilibrium values of the endogenous variables are determined by the following system:

$$G_1^* = V^1(L^A, L_1^B, L_2^B, T_1, T_2) \quad ,$$

$$G_2^* = V^2(L^A, L_1^B, L_2^B, T_1, T_2) \quad ,$$

$$L_1^{A*} = V^3(L^A, L_1^B, L_2^B, T_1, T_2) \quad .$$

As is the case for the myopic equilibrium, the determinant of the Jacobian to this system must be nonsingular to ensure the existence of a unique equilibrium. Non-myopic behaviour results in a substantially more complex system especially when type B individuals form the majority in at least one region. In this case, the sign of each element of $|J|$ cannot, in general, be unambiguously determined.[39] For the remainder of the analysis, a unique and stable equilibrium is assumed.

Is Public Goods Provision Under Myopic and Non-myopic Majority Voting Optimal?

In general, the condition for optimal public goods provision differs from the majority voting rule for provision of public goods in the migration equilibrium with myopic or non-myopic behaviour. A comparison of equations (III.23) with the myopic rule (III.14) shows that the rules governing public goods provision differ unless type A and type B individuals in a region have identical incomes. Only in this case does equation (III.23) collapse to the myopic rule. Even if incomes and the *rules* are identical, the level of public good provided in a migration equilibrium with myopic majority voting differs, however, from the optimum if the equilibrium distribution of mobile labour differs from the socially optimal population distribution. This issue is discussed further in chapter IV.

A comparison of the socially optimal rule and the non-myopic rule for public goods provision also shows that, in general, the level of public good provided in a non-myopic migration equilibrium differs from the socially optimal level. In this case, if all residents in a region have identical incomes, then the non-myopic rule, equation (III.25), collapses to the myopic rule as does the modified Samuelson rule. As above, if in the non-myopic equilibrium, the distribution of mobile population is different from the socially optimal level, then the level of public good provided by non-myopic majorities differs from the level of public good provided at the optimum.

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[39] See Appendix B for a discussion of this problem.

III.4 Migration Equilibrium and Majority Voting

Sections III.2 and III.3 demonstrate that, in general, the condition for the optimal provision of public goods differs from the majority voting decision rule for public goods provision and it is unlikely that the optimal provision of public goods and distribution of population (equation (III.24)) can be achieved as either a decentralized migration equilibrium with myopic or non-myopic behaviour. The optimal population issue is discussed further in Chapter IV. In addition, equations (III.14) and (III.25) show that public goods provision is influenced by assumptions regarding individual, and regional government, myopia. The discussion presented in this section examines under what circumstances assumptions regarding myopia matter for regional fiscal choices.

While explicit solutions for the migration equilibrium when individuals, and regional majorities, are either myopic or non-myopic cannot be obtained, it is possible to derive some general characteristics of this equilibrium.

Proposition 1. (Invariance Proposition)

If the mobile type forms the majority in both regions, the migration equilibrium is the same whether individuals are myopic or non-myopic with respect to the migration effects of their fiscal decisions.

Proposition 1 has an intuitive interpretation. In this case t=A and m=A. At the myopic equilibrium, the majority in each region chooses the level of the public good so as to maximize the utility of a representative type A resident. These choices must therefore satisfy the myopic first order conditions:

$$ {}_1U_G^A - \frac{{}_1U_x^A}{(L_1^A + L_1^B)} = 0 \quad , \tag{III.14.1} $$

and

$$ {}_2U_G^A - \frac{{}_2U_x^A}{(L^A - L_1^A + L_2^B)} = 0 \quad . \tag{III.14.2} $$

In addition, with myopic behaviour and costless mobility for type A individuals, the utility levels for type A individuals are equalized across regions.

Suppose we now assume that individuals are non-myopic. Regional majorities are, therefore, aware of the impact their fiscal decisions have on regional populations. In this case, there are no incentives to change the level of the public good in either region from its myopic level, since each type A individual has his/her preferred fiscal package. To see this, we examine the perceived migration response for region i:

$$\frac{\partial L_i^A}{\partial G_i} = \frac{-\left({}_iU_G^A - \frac{{}_iU_x^A}{L_i^A + L_i^B}\right)}{\left({}_1U_x^A \frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \frac{\partial x_2^A}{\partial L_1^A}\right)} , \quad i = \{1, 2\} \quad .$$

The numerator of $\partial L_i^A / \partial G_i$ is identical to the myopic first order condition and equals zero when evaluated using the myopic equilibrium solutions for G_i, G_j, and L_i^A. Since public goods provision by a myopic regional majority exactly satisfies the preferences of the mobile residents, the non-myopic type A majority perceives that it cannot influence the region's mobile population by adjusting the level of public good. When the perceived migration response equals zero, the non-myopic and myopic decision rules are identical. This is a straightforward application of the envelope theorem.

In this model, the type B minority has no power to indirectly affect the majority decision through migration or by any other means. The case where the minority can make transfers to the majority in an attempt to influence the provision of public good in the region is considered in chapter IV. Note that since type A individuals are identical, region i's choice, G_i, not only maximizes the utility of a type A individual in the region but, given the equal utilities condition for type A individuals, this choice also maximizes the utility of type A individuals in region j. This is an example of the complete incentive equivalence result like that discussed in Myers (1990).

Proposition 1 demonstrates that when type A majorities exist in both regions, the myopic and non-myopic decision rules used to determine public goods provision are identical. The assumption regarding individual myopia with respect to migration externalities makes no difference in the determination of the region's fiscal package. Thus, the regional levels of the public good and the distribution of type A labour in equilibrium are the same whether individuals are myopic or non-myopic. The assumption that the marginal product of one labour type is unaffected by changes in another labour input (i.e. there are no interactive effects in production between the type labour types) does not affect this result. This result is shown in appendix A. The assumptions that the minority population in each region is completely immobile and that the distribution of individual mobility costs corresponds exactly with the distribution of individuals by type are, however, critical to this result. Once either assumption is relaxed, myopia affects public goods provision and the equilibrium even when the perfectly mobile labour type forms the majority in both regions.

To see this consider the following examples. Suppose all individuals are identical and perfectly mobile. In this case, assumptions regarding myopia do not affect public goods provision or the migration equilibrium. Under these assumptions, the model reduces to the simple model presented in Boadway and Flatters (1982). Alternatively, if all individuals are of the same labour type but only a fraction of these individuals are mobile, myopia assumptions again play no role in public goods provision. In this case, there are two population groups within each region and one equal utilities condition for mobile individuals. Since the marginal product of all residents is the same and all residents face the same head tax, mobile and immobile individuals in the region have identical incomes. Regardless of whether individuals in the majority are mobile, the preferences of the minority are satisfied by the majority's choice of fiscal package. Therefore, each regional majority's perceived migration response equals zero at the myopic equilibrium, and public goods provision in equilibrium is invariant to alternative myopia assumptions.

Now consider the case where two labour types, type A and B, are introduced, and in contrast to the assumption adopted in this model, both labour types are mobile. Perfect mobility for both labour types increases the model's complexity significantly. Again, each region contains two population groups and now two equal utilities conditions must be satisfied in the migration equilibrium.[40] While no formal proof is offered here, it is not difficult to see that, under these conditions, myopic and non-myopic equilibria may differ even if the same mobile type forms the majority in both regions. As an example, consider the case where type A individuals form the majority in both regions. In this situation, the decisions of a myopic majority of mobile type A individuals, for example, may lead to migration of any mobile types, including those in the minority. Myopic behaviour prevents these migration externalities from being incorporated into fiscal decision-making.

Recall that the invariance proposition is derived from the fact that, when the minority is completely immobile and the preferences of mobile individuals in both regions are satisfied, the type A majority's perceived migration response equals zero in both regions. Hence, there are no incentives to move. Once individuals other than those in the majority are free to move, it is unlikely that the majorities' perceived migration responses equal zero. In very simple terms, if type A and B labour have different demands for the public good, then the myopic type A choice is suboptimal from the perspective of mobile, type B individuals in the region. With non-myopic behaviour, type A majorities believe they can influence their region's population of type B labour. Non-myopic fiscal choices are, therefore, likely to differ from myopic choices.

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[40] A variant on this would be to assume only a fraction of each labour type is mobile. The conclusions are, however, similar to the case where both labour types are completely mobile.

As proposition 2 below states, assumptions regarding individual myopia matter when immobile individuals form the majority in at least one region.

Proposition 2.

If the immobile type forms the majority in at least one region, the migration equilibrium is dependent on whether individuals are myopic or non-myopic with respect to the migration effects of their fiscal decisions.

To see this requires a closer examination of the decision rule for a non-myopic type B majority. Substituting $-1/(L_1^A+L_1^B)$ for $\partial x_1^B/\partial G_1$ into equation (III.25) yields the non-myopic decision rule for a type B majority in region 1 which equals zero in the non-myopic equilibrium:

$$\text{(III.30)} \qquad \left({}_1U_G^B - \frac{{}_1U_x^B}{(L_1^A + L_1^B)} \right) + \left({}_1U_x^B \frac{\partial x_1^B}{\partial L_1^A} \frac{\partial L_1^A}{\partial G_1} \right) = 0 \quad .$$

The first bracketed term represents the direct effect of a change in the level of the public good on the utility of a type B individual in the region and the second bracketed term captures the indirect utility effect of fiscally-induced migration. The above expression can be evaluated at the myopic equilibrium levels of G_1, G_2 and L^A_1 to examine whether a non-myopic majority has an incentive to change the level of public good from its myopic level. If the non-myopic first order condition is, for example, greater than zero at the myopic equilibrium, then the type B majority in region 1 has an incentive to increase the level of the public good above its myopic level.

At the myopic equilibrium, the first bracketed term equals zero. This is simply the first order condition to the myopic type B majority's maximization problem. As long as the indirect term is non-zero, non-myopic behaviour implies a different decision-making rule and level of public good.[41] If both regions have type B majorities then the optimal level of public good in each region differs from the optimal myopic level and, in general, the myopic and non-myopic equilibria differ. When a type B majority exists in only one region, the non-myopic equilibrium also differs from the myopic equilibrium since the non-myopic type B majority's optimal choice of public goods provision affects the other region's share of the mobile population and, consequently, affects the type A majority's fiscal choice. Thus, myopia matters if the immobile type forms the majority in at least one region.

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[41] Since ${}_1U^B_x$ is always positive, the indirect utility term equals zero only if either the perceived migration response or $\partial x^B_1/\partial L^A_1$ or both equal zero. The perceived migration response is zero if and only if type A and type B individuals in the region have identical incomes. $\partial x^B_1/\partial L^A_1$ represents the effect of a change in L^A_1 on per capita regional rents plus the indirect effect of a migration-induced change in the head tax required to finance public expenditures. Since the effect on per capita rents is ambiguous while the latter effect is unambiguously positive, $\partial x^B_1/\partial L^A_1$ is zero if and only if these two effects are equal in magnitude and opposite in sign.

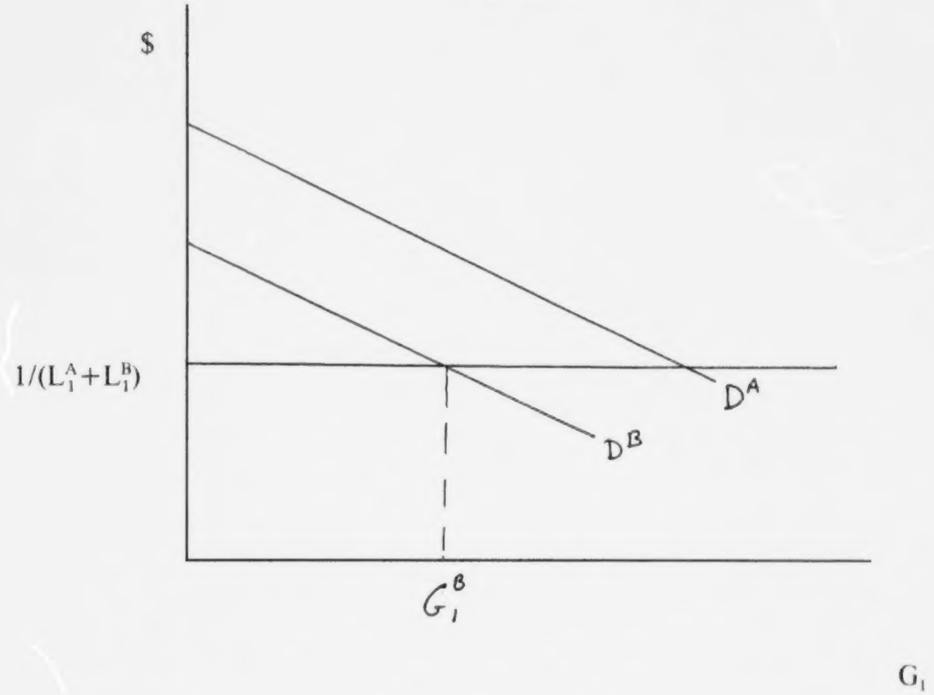
Consider an example where a type B majority exists in region 1 only. Suppose that in the myopic equilibrium, type A individuals in region 1 have higher incomes than type B individuals residing in the region. Figure III.4 illustrates this case. D^A and D^B represent a type A's and a type B's myopic equilibrium marginal benefit curves for the public good in region 1. D^A lies above D^B since type As are assumed to have higher incomes than type Bs. G_1^B represents the immobile majority's optimal choice of the public good in the myopic equilibrium. Thus, G_1^B satisfies equation (III.14) when t=B.

Now suppose individuals, and regional majorities, are non-myopic. Consider the perceived migration response for region 1's type B majority, evaluated at the myopic equilibrium:

$$\frac{\partial L_1^A}{\partial G_1} = \frac{-\left({}_1U_G^A - \frac{{}_1U_x^A}{L_1^A + L_1^B} \right)}{{}_1U_x^A \frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \frac{\partial x_2^A}{\partial L_1^A}} .$$

If stability of the migration equilibrium is imposed, the denominator of $\partial L_1^A/\partial G_1$ is negative. Since the income differential, $z_1^A - z_1^B$, is positive, the numerator is positive, indicating that type A individuals prefer a level of the public good higher than G_1^B. Therefore, $\partial L_1^A/\partial G_1$ is positive and region 1's type B majority perceives that by

Figure III.4



changing public goods provision, it can influence the size of the region's type A population. Whether the regional majority increases or decreases public goods provision, in turn, depends on how the utility of a representative type B individual is affected by changes in the region's mobile population.

Intuitively, a marginal increase in the level of public good brings provision closer to type A's preferred level. If the term, $\partial x_1^B/\partial L_1^A$, in equation (III.30) is positive, then the indirect utility effect from one unit of fiscally-induced migration, (${}_1U_x^B\ \partial x_1^B/\partial L_1^A$), is also positive. Given that the perceived migration response is positive, the indirect utility effect from fiscally-induced migration is positive and the type B majority in region 1 has an incentive to increase the level of G. This small change in G_1 disrupts the migration equilibrium since the fiscal package in region 1 is now closer to the package preferred by region 1's type A residents and increases the utility of type A individuals. Fiscally-induced migration of type A labour to region 1 generates additional changes in the marginal product of type A labour, in per capita rents and in the head tax for both regions. Migration occurs until the equal utilities condition is restored. The type A majority in region 2 chooses its level of public good to satisfy the non-myopic decision rule given by equation (III.25), which is identical to its myopic rule. Thus, if the distribution of mobile labour differs in the myopic and non-myopic equilibria, the non-myopic type A majority's choice of the public good differs from its myopic level.

Proposition 2 demonstrates that the non-myopic decision rules for public goods provision, in general, differ from the rules governing myopic choices as do the myopic and non-myopic equilibria. Since the total mobile population of type A individuals is fixed, non-myopic behaviour does not imply increased utility for all type B individuals. Consider the case where a type B majority exists in both regions. If both majorities attempt to increase their utility levels by increasing (decreasing) their shares of the mobile population, in equilibrium, only one region can succeed.[42]

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[42] If regions are identical in every respect (i.e. same endowments of type B labour and land, same production parameters, etc.), then the myopic equilibrium is characterized by each region having exactly one half of the mobile population. With the introduction of non-myopic behaviour, each type B majority has an incentive to change the public good by the exact same amount. As a result of symmetry, neither region succeeds in changing its share of the mobile population but public goods provision in both regions is now closer to the preferred levels of the type A residents in each regions. This increases (decreases) the utility of individuals in the minority (majority) relative to the myopic equilibrium.

While both regions believe that utility can be increased by acting non-myopically, in the migration equilibrium, one region's type B majority is worse off. The competition for more mobile population by non-myopic majorities should, however, unambiguously increase the welfare of all type A individuals in both regions, at least for small changes.

Since a non-myopic type B majority changes the level of the public good in the region closer to the level preferred by type A individuals, this has a positive first order effect on type A utility. However, as a result of the competition for type A labour, the equilibrium distribution of mobile labour changes which gives rise to secondary utility effects for the mobile individuals. These secondary effects may be positive or negative making it difficult to determine the overall effect on type A individuals of non-myopic behaviour. The equal utilities condition guarantees, however, that if type A utility increases in any one region, all type A individuals are better off in the non-myopic equilibrium.

Consider the following example. If type B majorities prefer smaller mobile populations, then the level of public good provided in the region is moved further away from the level preferred by type A residents. This has a negative first order impact on type A utility. Again, there are the secondary utility effects, through changes in per capita rents, the marginal product of mobile labour, etc. that arise as a result of the new equilibrium distribution of mobile labour which can be positive or negative. Thus, the overall effect of non-myopic behaviour on type A utility is indeterminate.

III.5 A Numerical Example

Comparisons of utility levels and the levels of the endogenous variables under the alternative myopia assumptions are difficult to make given the general nature of the model and are dependent on the relative strengths of the regional incentives to encourage or discourage migration using fiscal tools. In general, whether the non-myopic choices of public goods provision in both regions are higher or lower relative to the myopic levels depends on the parameters of the model. To illustrate the effects of myopia on the provision of public goods and the migration equilibrium, the model is computed numerically for the case where the immobile type forms the majority in both regions. This example also allows for an examination of welfare levels in the myopic and non-myopic equilibria.

Two numerical examples are presented to illustrate that non-myopic behaviour can lead to higher or lower levels of public goods provision relative to the myopic equilibrium and that non-myopic behaviour need not make everyone better off. Regional production is assumed to be Cobb-Douglas in nature and is written as:

$$y_i = S_i \left((T_i^A)^{(1-\alpha)}(L_i^A)^{\alpha} + (T_i - T_i^A)^{(1-\beta)}(L_i^B)^{\beta}\right) \quad , \tag{III.31}$$

where $0 < \alpha < 1$, $0 < \beta < 1$, and S_i is a technology parameter. Each region's endowment of land is exogenously allocated between the two labour types. A Cobb-Douglas utility function of the form:

$$U(x_i^h, G_i) = (x_i^h)^{\rho}(G_i)^{(1-\rho)} \quad , \tag{III.32}$$

is chosen to represent individual preferences. Using these specifications for production and utility, explicit forms of the myopic and non-myopic decision rules can be derived.

The parameter values, presented in table III.1, show that production parameters α, β, S_1 and S_2 and utility parameter, ρ, are the same in both regions. Regional endowments of land are assumed to differ with region 1 having the larger endowment. The more interesting case to consider numerically is when the immobile labour type forms the majority in both regions. This allows for an examination of how type B utility levels are affected when both regions compete for a greater share of mobile labour. The population parameters for the model are chosen such that type B individuals form the majority in both regions and that these majorities are equal in size. Thus, the results are driven by differences in regional land endowments, majority voting and the alternative myopia assumptions.

Table III.1: Parameter Values

T_1	1000	$S_1 = S_2$	50
T_1^A	500	α	0.5
T_2	800	β	0.75
T_2^A	400	ρ	0.75

Table III.2 presents the computed equilibria for two numerical examples. For case I, the assumption of non-myopic behaviour results in a larger (smaller) type A population in region 2 (1), increased utility for all type A individuals and for type B individuals in region 2, and lower utility for type B individuals in region 1, relative to the myopic equilibrium. Public goods provision is greater in both regions in the non-myopic equilibrium. In contrast, case II shows that public goods provision is lower in both regions when individuals are non-myopic. Region 1 (2) has a larger share of the mobile population and all type A individuals have higher utility in the non-myopic equilibrium as do type B individuals in region 1. Type B individuals in region 2, however, are worse off given non-myopic behaviour.[43]

Table III.2: Myopic and Non-myopic Equilibrium Solutions When Type B Majorities Exist in Both Regions

	Case I		Case II	
Variables	**(1) Myopic**	**(2) Non-Myopic**	**(3) Myopic**	**(4) Non-Myopic**
L_1^B **and** L_2^B	2,500	2,500	750	750
L_1^{A*}	464.91	464.79	477.72	478.36
L_2^A	335.09	335.21	322.28	321.64
G_1	26,826.20	26,861.84	15,572.72	15,283.48
G_2	24,039.26	24,204.06	12,837.66	12,670.17
$U(x_1^A,G_1)=U(x_2^A,G_2)$	155.74649	155.76039	142.27951	142.40930
$U(x_1^B,G_1)$	152.19191	152.18997	171.15181	171.15649
$U(x_2^B,G_2)$	141.03824	141.03930	156.16911	156.14549

* L^A is set equal to 800 in both examples.

These results highlight two important results of the model. Myopia assumptions matter for regional levels of public goods, welfare and the regional distribution of mobile labour, illustrating proposition 2. In addition, non-myopic behaviour can lead to higher or lower levels of public goods provision relative to their myopic levels. What determines whether or not the type B majority in a particular region is better or worse off in the non-myopic equilibrium? Recall at the myopic equilibrium, if we assume regional majorities are non-myopic and Nash competitors, each type B majority perceives it can influence its mobile population. For the parameters in table III.1, non-myopic type B majorities always prefer more type A residents than exists at the myopic equilibrium. Thus, the question becomes how to attract more mobile individuals into the region when the only fiscal instrument available is the level of the public good.

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[43] The stability condition is satisfied in both the myopic and non-myopic equilibria.

The ability of type B majorities to influence the migration of mobile individuals into their region depends on the extent to which mobile individuals are dissatisfied with the myopic majority's fiscal package. The income differential between type A and B individuals in the region at the myopic equilibrium provides a measure of this dissatisfaction. Both the size and the sign of the income differential influences the perceived migration effect. Whether or not a region attempts to lure more mobile individuals into the region by changing the level of the public good is determined by the sign of the income differential. The size of the differential determines the extent to which the level of public good changes from the myopic to the non-myopic equilibrium. All other things equal, the region with the greatest income differential changes its fiscal package the most and is, therefore, more likely to increase its share of the mobile population in the non-myopic equilibrium.

For example, if the income differential, $(z_i^A - z_i^B)$, is positive in both regions, as in case I, all type A residents prefer a fiscal package that offers more of the public good than exists in the myopic equilibrium. Both regional type B majorities have an incentive to increase the level of the public good over the myopic level to bring provision closer to the level preferred by the type A minority. In case I, this income differential is greater in region 2 and, as a result, region 2 is more likely to be successful at increasing its type A population in the non-myopic equilibrium. The results in table III.2 demonstrate this, showing an increase in region 2's type A population over its myopic level. Although both regional majorities perceive that the region's mobile population can be increased over the myopic level, only one region is successful. Since regions prefer a larger type A population, this implies region 2's type B majority are better off in the non-myopic equilibrium.

In case II, region 1 has the larger income differential and successfully increases its mobile population in the non-myopic equilibrium. Since $z_i^A - z_i^B$ is negative for both regions, both type B majorities have incentives to provide a lower level of public good in the non-myopic equilibrium to bring public goods provision closer to the level preferred by type A residents. The type B majority that increases its mobile population in the non-myopic equilibrium also has higher utility in the non-myopic equilibrium while the unsuccessful majority has lower utility relative to the myopic equilibrium. This result is illustrated in table III.2. Note that in both numerical examples considered, all type A individuals are better off if regional majorities act non-myopically.

III.6 Conclusions

This chapter develops a regional model to show how assumptions regarding individual, and regional government, myopia can influence the provision of regional public goods and migration when fiscal decisions are made according to majority voting. The model shows that public goods provision with majority voting is suboptimal since the majority voting rule differs from the modified Samuelson rule derived from the social planner's problem. When individuals are heterogeneous and public goods are financed by uniform head taxes, majority voting decisions are invariant to myopia assumptions only when perfectly mobile individuals form the majority in both regions and regional minorities are immobile.

While the invariance proposition applies in limited circumstances only, the model shows that behaviourial assumptions influence regional majorities' fiscal choices and the migration equilibrium. In particular, proposition 1 depends critically on the assumption that one of the two labour types considered is completely immobile and is unlikely to hold once the assumption of immobile type B individuals is relaxed to allow for imperfect or costly mobility.

Intraregional income differentials between individuals in the minority and majority determines the sign and the strength of the perceived migration response in both regions. Generally, the non-myopic type B majority in the region with the greatest income disparity has the greatest opportunity to change the level of public good from the myopic to non-myopic equilibrium and this, combined with the larger income differential, increases the likelihood that it is more successful at increasing its members' utility from the myopic level. This result also depends on the extent of labour mobility.

Earlier models have demonstrated the importance of the myopia assumption when regional authorities choose the level of the public good to maximize the utility of a representative resident and all individuals are identical. For example, Boadway (1982) shows that individual myopia can affect the efficiency in the provision of local public goods. In a model where regional transfers are excluded and property taxation is used to finance the public good, myopic regional authorities have incentives to over-provide the public good relative to the Samuelson level. Contrary to the model presented here, Boadway (1982) shows that, if the public good is financed by direct taxation, myopia leave the provision rule unchanged and the level of provision at the Samuelson level. Myers (1990) demonstrates that regional authorities make voluntary interregional transfers sufficient to restore the optimal allocation of labour when these authorities are non-myopic with respect to the impact of their fiscal decisions on migration. Non-myopic behaviour in Myers' model also ensures that public goods provision is optimal. In contrast, in this model, majority voting leads to a suboptimal level of public goods provision relative to the social optimum.

Following Myers (1990), Mansoorian and Myers (1993) and Burbidge and Myers (1994), this model could be extended to include interregional transfers as additional regional fiscal instruments. With this extension, the model could examine under what circumstances voluntary transfers are made by non-myopic regional majorities and whether, by changing the set of available fiscal instruments, the need for centrally-coerced transfers to achieve a social optimum is eliminated. These issues are pursued in chapter IV. It would also be useful to explain, from a public choice perspective, the existence of a federal or central authority in a regional model of this nature and to determine the effects of alternative federal government objectives on the migration equilibrium. This idea is developed further in chapter V. A richer regional tax structure might also be a fruitful avenue to explore in the context of interregional migration and majority voting. The model could also be extended to include explicit redistribution within regions as is done in Burbidge and Myers (1994). The impact on redistribution of majority voting when incomes are endogenous could then be examined and compared to Burbidge and Myers (1994) as well as to the recent work of Epple and Romer (1991) on majority voting and redistribution when incomes are exogenous.

Chapter IV. Majority Voting and Transfers

The model developed in chapter III examines public goods provision when regional government decisions are determined by majority voting and financed using the revenues from a uniform head tax. The discussion focuses on the incentives of regional majorities to provide local public goods under alternative assumptions regarding individual and regional government myopia. Two propositions are derived in chapter III. The first proposition shows that the migration equilibrium is invariant to the alternative myopia assumptions when perfectly mobile individuals form the majority in both regions. Proposition 2 demonstrates that public goods provision and the migration equilibrium are, however, dependent on whether majorities are myopic when an immobile majority exists in at least one region. The model also demonstrates that a migration equilibrium, with either myopic or non-myopic majority voting, generally fails to achieve the optimal level of public goods provision or the optimal distribution of population.

These propositions are derived from the fact that, under certain conditions, non-myopic majorities can influence the region's mobile population through its choice of public goods provision. Thus, a non-myopic majority can potentially affect the location decisions of mobile individuals who are dissatisfied with the region's fiscal package. A majority comprised of myopic type A individuals chooses the fiscal package to maximize the utility of a type A resident and, since type A individuals have equal utility in equilibrium, this choice also maximizes the utility of all type A individuals in the economy. The minority in this case is immobile. While individuals in the majority are mobile, they have no incentives to move given the myopic fiscal choices of the type A majority satisfies their preferences. As a result, a non-myopic type A majority need not exercise any control over immigration into the region. In contrast, a majority comprised of myopic immobile individuals has some control over immigration into the region through its choice of public goods since the mobile minority is, in general, dissatisfied with the myopic majority's fiscal choice.

In chapter III, it is assumed that the minority has no means of directly influencing the majority's choice of public goods provision. In other words, minority side payments or bribes to the majority are not permitted. In addition, the provision of a pure local public good and a uniform head tax are the only fiscal instruments available to regional majorities. With diverse preferences for the fiscal package and majority voting, there may be incentives for regional *minorities* to make intraregional transfers to the majority, an issue that has not been explored in the fiscal externality context. Section IV.1 of this chapter demonstrates that, in the absence of free riding and labour mobility, a minority has an incentive to voluntarily transfer income to individuals in the majority only if the minority's income exceeds the income of individuals in the majority. Once labour mobility is introduced, this condition on relative incomes is no longer necessary or sufficient to ensure positive intraregional transfers exist in equilibrium if individuals are non-myopic with respect to the migration effects of their fiscal decisions.

When regional majorities are non-myopic and aware of the migration effects of their fiscal choices, regional *majorities* may desire a fiscal instrument that allows greater control over the region's population or immigration. The model developed in chapter III is extended here to consider incentives to make voluntary transfers across regions when fiscal decisions are determined by majority voting and whether these incentives are sufficient to restore optimality in public goods provision or in the distribution of population across regions.

Transfers across regions represent another policy instrument that regional majorities may use to achieve their fiscal objectives since transfers permit the government to exercise some control over immigration into the region. Incentives for interregional transfers when regional fiscal decisions are determined by majority voting have not been examined in the fiscal externality literature, although these incentives are examined using the fiscal externality framework in Myers (1990), Hercowitz and Pines (1991) and others. With the exception of Burbidge and Myers (1994), fiscal externality models that examine regional government's incentives to make transfers, generally assume that all individuals are identical with respect to their demands for the local fiscal package. Hence, no collective choice mechanism is required in a region to reconcile diverse preferences. In Burbidge and Myers (1994), although preferences for the fiscal package are diverse, regional fiscal decisions are determined by a generalized social welfare function rather than an explicit choice mechanism like majority voting.

Myers (1990), for example, adopts the basic framework of Boadway and Flatters (1982) to examine regional incentives to make interregional transfers in a world of costless mobility, individual homogeneity and non-myopic regional governments. In the absence of such transfers, Myers' model is similar to the Boadway and Flatters model where public goods are chosen according to the Samuelson condition but the migration equilibrium fails to achieve an optimal distribution of population.[44] Hence, centrally-coerced transfers are required to restore optimality. With the introduction of voluntary transfers, non-myopic regional governments now have a greater ability to control immigration and determine the region's population. Myers shows that the migration equilibrium is necessarily characterized by a net voluntary interregional transfer between regions and this transfer ensures that the social optimum is attained. Under these conditions, no centrally-coerced transfers are required.

Recent contributions to this literature extend Myers' analysis to examine the effects of relaxing some of the stronger assumptions of the model, in particular the assumptions of individual homogeneity and costless mobility, on regions' incentives to make transfers. Individual heterogeneity is introduced into a standard fiscal externality model with local public goods in Mansoorian and Myers (1993) by assuming individuals have different levels of attachment to a particular region. Residents' demands for the fiscal package are, however, uniform. In this context, voluntary transfers, which regions use to purchase a preferred population, need not exist in equilibrium. Individual heterogeneity, in the form of individual differences in preferences and productivity, is also explored in Burbidge and Myers (1994).

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[44] The only difference between the two models is the structure of land ownership. Boadway and Flatter's inefficiency result is also present if Myers' land ownership assumption is adopted.

Regional governments have exogenously determined preferences for redistribution among the region's residents, described by a general social welfare function. When regional preferences for redistribution differ, voluntary interregional transfers may or may not occur in equilibrium and, voluntary transfers, if made, do not ensure an optimal allocation of labour across regions. Finally, the effects of costly mobility on the incentives for interregional transfers are examined in Hercowitz and Pines (1991) where labour productivity is stochastic and region-dependent, and all individuals are ex-ante identical and face the same mobility costs. There are no public goods in this model but rather the fiscal externality arises as a result of regional differences in rents and rent-sharing. Under these assumptions, a voluntary interregional transfer occurs in equilibrium but does not ensure optimality in the allocation of labour unless mobility costs are zero.

The general conclusion to emerge from these developments is that non-myopic regional authorities, aware of the effects of their fiscal decisions on the region's mobile population, may or may not make voluntary interregional transfers in the equilibrium in order to purchase a preferred population and exploit gains from trading. In general, these voluntary transfers permit regions to exert some control over immigration and the region's population but guarantees a social optimum only under limited circumstances. The analysis presented in section IV.2 and IV.3 of this chapter shows a similar finding for this model. Only in Myers (1990) where there is complete incentive equivalence and in Mansoorian and Myers (1993) does the introduction of voluntary transfers ensure that the migration equilibrium is efficient.

With the exception of Burbidge and Myers (1994), voluntary transfers in these models increase the utility of individuals in the region making the transfer as well as the utility of individuals in the transfer-receiving region. This contrasts with the results presented in section IV.3 which shows that, although transfers may exist in equilibrium, transfers need not improve the utility of all individuals relative to the no transfer equilibrium.

Note that these recent developments focus primarily on the incentives for interregional transfers. In most of these models, behaviour is non-myopic but individuals are not heterogeneous with respect to their demands for a fiscal package and thus regional governments simply maximize the utility of a representative individual. As a result, the region's fiscal choice maximizes the utility of all residents and there are no incentives for *intraregional* transfers. Thus, the examination of intraregional and interregional transfers given diverse fiscal preferences and majority voting represents a significant and valuable departure from the existing literature.

This chapter begins with a discussion of the incentives for intraregional transfers presented in section IV.1. The remainder of the chapter is devoted to the issue of voluntary interregional transfers. In section IV.2, the model in chapter III is extended to include voluntary interregional transfers. Regional decision rules governing public goods provision and voluntary transfers are derived given majority voting, uniform taxation and perfect mobility for type A individuals. Several propositions characterizing the migration equilibrium are then derived in section IV.3. Section IV.4 relates the results of this model to the results of similar fiscal externality models and offers conclusions.

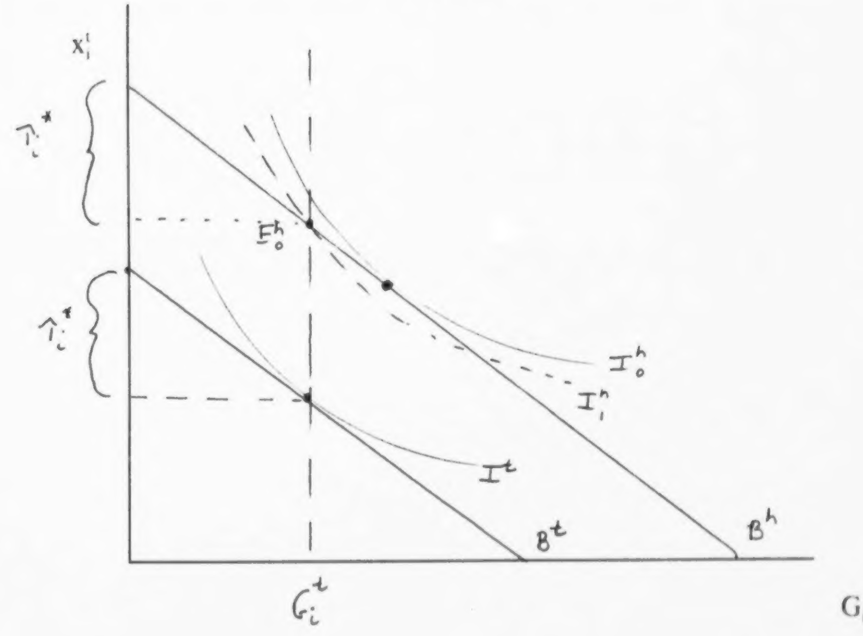
IV.1 Incentives For Intraregional Transfers and Majority Voting

The model presented in chapter III shows that the fiscal package, as determined by either a myopic or non-myopic majority, is seldom optimal from the perspective of individuals in the minority when intraregional preferences are diverse. Unless all residents in the region have identical incomes, the preferences of those in the minority are not satisfied by the majority's fiscal choice. Thus far in the analysis, regional minorities are unable to influence the majority's decision except through mobility decisions. When the number of regions is finite and relatively small, this mobility does not ensure that all individuals find their preferred fiscal package. Consequently, regional minorities may desire to make an income transfer to individuals in the majority to induce the majority to adjust the fiscal package closer to that preferred by the minority. Using the model in chapter III, these incentives are examined first for the case where there is no labour mobility between regions. Following this, mobility is introduced into the model and the incentives for intraregional transfers from the minority to the majority are reexamined.

Intraregional Transfers and Immobile Individuals

Chapter III shows that the majority-determined fiscal package is suboptimal from the perspective of individuals in the minority when there are intraregional income differentials. In this case, it may be worthwhile for the minority to voluntarily transfer income to the majority in exchange for the majority's promise to provide the public good at a level closer to that preferred by individuals in the minority. Using chapter III's notation, assume that type t individuals form the majority and type h individuals form the minority in region i. Consider the example where the level of the public good is too low given the income of an individual in the minority (i.e. the marginal product of a type h individual is higher than the marginal product of a type t individual). Figure IV.1 below shows the majority's choice of G_i^t as determined by the point of tangency between a type t's budget constraint, B^t, and indifference curve, I^t. The preferred choice of a representative type h individual is given by the point of tangency between B^h and I_0^h. Given the majority's choice of head tax, τ_i,

Figure IV.1



minority members' actual consumption bundle is given by E_0^h which corresponds to a lower level of utility, I_1^h. At E_0^h:

$$\frac{{}_iU_G^h}{{}_iU_x^h} > \frac{1}{L_i^h + L_i^t} \quad where \quad h \in \{A, B\} \quad and \quad t \in \{B, A\} \quad ,$$

indicating that the level of public good is too low for individuals in the minority.

Assuming that the minority is able to form a coalition, the general problem faced by the minority in region i is to choose a voluntary intraregional transfer, B_i, to maximize[45]:

$$U(x_i^h, G_i) \quad ,$$

where

$$x_i^h = F_i^h + \left(\frac{R_i - G_i}{L_i^h + L_i^t}\right) - \frac{B_i}{L_i^h} \quad .$$

When choosing B_i the minority takes as given the majority decision rule for local public goods provision for the case with no mobility derived in chapter III:

(IV.1) $$ {}_iU_G^t - \frac{{}_iU_x^t}{(L_i^h + L_i^t)} = 0 \quad .$$

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[45] Problems of free riding and enforcement are discussed later in this section.

Implicit in this formulation is the assumption that the majority operates on its demand curve for the public good. Each individual in the minority contributes an equal amount of income, B_i/L_i^h, to finance the transfer which is shared equally among individuals in the majority. The first order condition to the minority's problem is:

$$\text{(IV.2)}\quad \frac{-{}_iU_x^h}{L_i^h} + {}_iU_G^h\left(\frac{\partial G_i}{\partial B_i}\right) + {}_iU_x^h\left(\frac{\partial x_i^h}{\partial G_i}\right)\left(\frac{\partial G_i}{\partial B_i}\right) \leq 0,\ B_i \geq 0 \textit{ and } B_i\frac{\partial U(x_i^h, G_i)}{\partial B_i} = 0\ .$$

Substituting $1/(L_i^h + L_i^l)$ for $\partial x_i^h/\partial G_i$ and rearranging equation (IV.2) yields:

$$\text{(IV.3)}\qquad {}_iU_G^h\left(\frac{\partial G_i}{\partial B_i}\right) = \frac{{}_iU_x^h}{L_i^h} + \frac{{}_iU_x^h}{(L_i^h + L_i^l)}\left(\frac{\partial G_i}{\partial B_i}\right)\ .$$

Equation (IV.3) describes the minority's optimal transfer and has a straightforward economic interpretation. The lefthand side of this equation represents the marginal benefit of the intraregional transfer or the change in the utility of a minority type individual from a transfer-induced change in the level of the public good. The righthand side represents the marginal cost of the transfer to an individual in the minority. The first term, ${}_iU_x^h/L_i^h$, captures the direct cost of a transfer in terms of the loss in private good consumption (each individual has a lower disposable income after paying his or her share of the transfer). There is also a transfer-induced change in the level of public good provided by the majority which that a change in the head tax needed to finance the new level of expenditures. If G_i increases as a result of the transfer then τ_i must also increase. This lowers the private good consumption of all individuals in the region. The second term in equation (IV.3) represents this indirect cost to an individual in the minority. The minority coalition has an incentive to increase its transfer to the majority until the marginal benefit of the transfer just equals its marginal cost. If, for all positive transfers, the marginal cost of a transfer exceeds the marginal benefit, then the intraregional transfer is set to zero.

The transfer-induced change in public goods provision, $\partial G_i/\partial B_i$, is found by totally differentiating the majority's first order condition (equation (IV.2)) and solving for $\partial G_i/\partial B_i$. This gives:

$$(\text{IV.4}) \qquad \frac{\partial G_i}{\partial B_i} = \frac{-\left(\frac{{}_iU^l_{Gx}}{L_i^l} - \frac{{}_iU^l_{xx}}{L_i^l\left(L_i^h + L_i^l\right)} \right)}{\left({}_iU^l_{GG} + \frac{{}_iU^l_{xx}}{\left(L_i^h + L_i^l\right)^2} - \frac{2\,{}_iU^l_{Gx}}{\left(L_i^h + L_i^l\right)} \right)} > 0 \quad .$$

The assumptions on preferences described in chapter III imply that both the numerator and denominator are negative. Therefore, $\partial G_i/\partial B_i$ is unambiguously positive. This result is intuitive since an increase in income increases the demand for any normal good.

Suppose initially that the regional minority does not make a transfer to the majority so that we are in a "no-transfer" equilibrium. The minority's incentives to make a positive intraregional transfer can be examined by substituting equation (IV.4) into the minority's first order condition, equation (IV.3), and evaluating the resulting expression at the majority's choice of public good in the no-transfer equilibrium. If this expression is positive, the minority has an incentive to make a positive income transfer to the majority in exchange for an adjustment in the level of public goods provision.

Proposition 3.

In the absence of free riding and labour mobility, a minority voluntarily transfers income to the regional majority to "purchase" a fiscal package closer to their preferred package only if individuals in the minority have more income than individuals in the majority and the marginal benefit of a transfer exceeds its marginal cost.

A necessary but not sufficient condition for a positive intraregional transfer is:

$$\left({}_iU_G^h - \frac{{}_iU_x^h}{L_i^h + L_i^l} \right) > 0 .$$

The lefthand expression measures how the majority's fiscal choice satisfies the preferences of an individual in the minority. This condition is positive only if the marginal product of the labour type in the minority exceeds the marginal product of the labour type that forms the regional majority.

To see this consider first the case where this condition is not satisfied in either region so that individuals in the minority have a lower marginal product (and therefore income) than individuals in the majority. Does the minority have any incentive to make a transfer to the region's majority coalition? Relative to the minority's preferred choice, the level of the public good is too high. Since the only instrument available to the minority is an income transfer, the minority chooses a positive income transfer only if the majority coalition agrees to provide a lower level of the public good. Given a positive income elasticity of demand for the public good, an increase in income for individuals in the majority implies, however, that the majority's demand for the public good increases. Without a means of enforcing the agreement, the majority's promise to lower the public good in exchange for a side payment is not credible. Thus, under these circumstances, the minority chooses a zero transfer.[46]

If, however, the marginal product of a type h individual exceeds the marginal product of a type t individual, region i's minority chooses a positive intraregional transfer if:

$$\frac{\partial G_i}{\partial B_i}\left({}_iU_G^h - \frac{{}_iU_x^h}{L_i^h + L_i^t} \right) > \frac{{}_iU_x^h}{L_i^h} \quad ,$$

the marginal benefit of the transfer exceeds its direct cost. The bracketed term in the lefthand expression is a measure of how the majority's fiscal choice satisfies the preferences of those in the minority. The term on the righthand side represents the direct cost per minority member of making an intraregional transfer, measured in terms of the numeraire.

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[46] In an infinitely repeated game, it may be possible to extract a credible promise from the majority in exchange for a minority side payment depending on the discount rate.

If minority preferences are satisfied by the majority's choice of public goods then the bracketed term in the lefthand expression equals zero. In this case, the minority has no incentive to make a transfer. With a positive income differential between individuals in the minority and the majority, $(z_i^h - z_i^l) > 0$, this lefthand expression is positive. The larger is this income differential, the more positive is this expression and the more costly it is, in utility terms, to be in the minority. All else equal, the larger the income differential the greater is the minority's incentive to make a transfer to the majority. In effect, the higher income individuals in the minority use the transfer to relax the uniform taxation constraint imposed on the majority. If a minority chooses a positive transfer in equilibrium, higher income individuals voluntarily pay higher taxes than lower income individuals and, in doing so, directly affect the level of public goods provision in the region. This contrasts with a proportional income tax system, for example, where higher income individuals also pay higher taxes but the minority has no power to directly affect public goods provision as determined by the regional majority.

Proposition 3 describes a regional minority's incentives to make transfers to the majority when there is no free riding problem or labour mobility. However, free riding and enforcement issues may represent significant barriers to side payments of this nature, especially if the minority is large in absolute terms and if the minority is not formally organized.

Proposition 4.

Without an enforcement mechanism, the free rider problem precludes a minority side payment to the regional majority in equilibrium.

Without a formal organization, the minority group has limited means at its disposal to enforce participation in the transfer scheme and prevent free riding. If participation in the minority's transfer scheme is viewed as a non-cooperative game, the dominant strategy for a minority member is to free ride. If all other members of the minority contribute their share of the transfer and the free rider does not, both the equilibrium level of public goods and the utility of the free rider increase. As the free rider does not contribute to the transfer, this increase in utility is costless. Since individuals in the minority are identical, each has an incentive to play the same Nash strategy. Consequently, a zero intraregional transfer results in equilibrium, demonstrating proposition 4.

The effects of labour mobility on regional minorities' incentives to make voluntary intraregional transfers are considered below.

Intraregional Transfers and Mobile Type A Individuals

Propositions 3 and 4 are derived under the assumption that all individuals are immobile. With the introduction of costless mobility for type A individuals, the incentives for the regional minority to make an income transfer to the regional majority can be reexamined. In this case, it is necessary to specify whether or not individuals are myopic with respect to the migration effects of their fiscal decisions since this determines the form of the majority's decision rule for public goods provision.

Intraregional Transfers With Myopic Behaviour

If individuals are myopic, the minority's problem is similar to that described above. The minority continues to choose the intraregional transfers to satisfy equation (IV.2), the majority chooses the fiscal package to satisfy equation (IV.1) and the transfer-induced change in public goods provision is given by equation (IV.4). In equilibrium, regional levels of public goods provision, intraregional transfers and the interregional allocation of mobile labour are determined by a five equation system consisting of a myopic majority voting rule for public goods provision and a myopic minority rule for the intraregional transfer for each region plus the equal utilities condition for type A individuals. Since regions are now linked via migration, equilibrium solutions for public goods, and intraregional transfers are likely to differ from the no migration case. However, since minority and majority behaviour are described by the same rules, propositions 3 and 4 hold in this case.

Intraregional Transfers With Non-myopic Behaviour

If individuals are non-myopic, then the minority chooses B_i to maximize the utility of a representative from the minority taking as given the non-myopic majority rule for public goods provision and the equal utilities condition, given as equations (III.25) and (III.7) respectively. The first order condition to this problem is:

$$\text{(IV.5)}\quad -\frac{{}_iU_x^{\,h}}{L_i^{\,h}} + {}_iU_G^h\left(\frac{\partial G_i}{\partial B_i}\right) + {}_iU_x^h\left(\frac{\partial x_i^{\,h}}{\partial G_i}\right)\left(\frac{\partial G_i}{\partial B_i}\right) + {}_iU_x^h\left(\frac{\partial x_i^{\,h}}{\partial L_i^{\,A}}\right)\left(\frac{\partial L_i^{\,A}}{\partial B_i}\right)$$

$$+ {}_iU_x^h\left(\frac{\partial x_i^{\,h}}{\partial L_i^{\,A}}\right)\left(\frac{\partial L_i^{\,A}}{\partial G_i}\right)\left(\frac{\partial G_i}{\partial B_i}\right) \leq 0,\ B_i \geq 0 \ \text{and}\ B_i\frac{\partial U(x_i^{\,h}, G_i)}{\partial B_i} = 0.$$

This rule differs from the myopic rule with the addition of a fourth and fifth term. Given non-myopic behaviour, in addition to the direct effect of a transfer on public goods provision, a non-myopic minority must now consider both the direct and indirect effects of the transfer on migration. Since the transfer affects the income and utility of mobile individuals, a intraregional transfer has a direct impact on migration, measured as $\partial L_i^A/\partial B_i$. The intraregional transfer also affects public goods provision in the region and therefore indirectly affects the welfare and migration decisions of mobile individuals. The term, $(\partial L_i^A/\partial G_i)(\partial G_i/\partial B_i)$, captures this indirect effect.

Totally differentiating the equal utilities condition, the following migration response functions can be obtained:

$$\text{(IV.6)}\qquad \frac{dL_i^{\,A}}{dG_i} = \frac{\partial L_i^{\,A}}{\partial G_i} = \frac{-\left({}_iU_G^A - \dfrac{{}_iU_x^{\,A}}{L_i^{\,A}+L_i^{\,B}}\right)}{\left({}_iU_x^{\,A}\dfrac{\partial x_i^{\,A}}{\partial L_i^{\,A}} - {}_jU_x^{\,A}\dfrac{\partial x_j^{\,A}}{\partial L_i^{\,A}}\right)},$$

and

(IV.7) $$\frac{dL_i^A}{dB_i} = \frac{\partial L_i^A}{\partial B_i} = \frac{\dfrac{-{}_iU_x^A}{L_i^A}}{\left({}_iU_x^A \dfrac{\partial x_i^A}{\partial L_i^A} - {}_jU_x^A \dfrac{\partial x_j^A}{\partial L_i^A}\right)} ,$$

where $\partial x_i^A/\partial L_i^A$ and $\partial x_i^B/\partial L_i^A$ are:

$$\frac{\partial x_i^A}{\partial L_i^A} = \frac{F_i^{AA} L_i^B}{L_i^A + L_i^B} - \frac{R_i - G_i}{(L_i^A + L_i^B)^2} - \frac{B_i}{(L_i^A)^2} ,$$

and

$$\frac{\partial x_i^B}{\partial L_i^A} = \frac{-F_i^{AA} L_i^A}{L_i^A + L_i^B} - \frac{R_i - G_i}{(L_i^A + L_i^B)^2} .$$

Assuming the migration equilibrium is stable, the denominator of $\partial L_i^A/\partial B_i$ is negative which implies that an increase in the minority's transfer to the majority induces migration of type A labour into the region or $\partial L_i^A/\partial B_i$. Equilibrium levels of G_1, G_2, B_1, B_2 and L_1^A are determined by a five equation system including a non-myopic majority rule for public goods provision for each region, given by equation (III.25), a non-myopic minority rule for each region's intraregional transfer, given by equation (IV.5), and the equal utilities condition.

The transfer-induced change in public goods provision is found by totally differentiating the non-myopic majority's decision rule for public goods provision and solving for $\partial G_i/\partial B_i$. Since the form of this decision rule depends on the majority's identity, we consider first the case where a type A majority exists in region i. In this case, the perceived migration response, $\partial L_i^A/\partial G_i$, equals zero and equation (III.25) collapses to equation (IV.1), the myopic public goods provision rule. $\partial G_i/\partial B_i$ is derived as above and is given by equation (IV.4) for t=A. Thus, the non-myopic minority chooses B_i to satisfy:

$$\text{(IV.8)} \qquad \frac{-{}_iU_x^B}{L_i^B} + \frac{\partial G_i}{\partial B_i}\left({}_iU_G^B - \frac{{}_iU_x^B}{L_i^A + L_i^B} \right) + {}_iU_x^B \frac{\partial x_i^B}{\partial L_i^A}\frac{\partial L_i^A}{\partial B_i} = 0 \ .$$

In contrast to the no mobility case, it is no longer necessary that individuals in the minority have higher incomes than the mobile individuals in the majority for a positive intraregional transfer to occur in equilibrium.

Consider the case where migration has a positive effect on income, $\partial x_i^B/\partial L_i^A > 0$. The type B minority takes into consideration not only the direct effect of a intraregional transfer on public goods provision but also the indirect effect on migration. For example, suppose individuals in the minority have lower income than individuals in the majority so that the bracketed term in equation (IV.8) is negative. It is possible for the minority to make a positive transfer to the majority if the income effect from migration is positive and larger than the direct cost of the transfer and any negative effect on public goods provision combined. Therefore, proposition 3 does not apply to the case where individuals are non-myopic and mobile individuals form the majority.

If, on the other hand, type B individuals form the majority in the region, $\partial G_i/\partial B_i$, is derived by totally differentiating equation (III.25) for t=B, the result of which is a substantially complicated expression. In this case, the effect of an intraregional transfer on the majority's choice of public good is ambiguous. The transfer may affect the income of type B individuals in the majority and public goods provision but it may also affect the majority's perceived migration response which itself depends on the extent to which minority individuals are dissatisfied with the majority's choice of fiscal package. Here, it is possible for the minority to use its transfer as a means of increasing or decreasing public goods provision in the region and indirectly influencing the size of the region's mobile population. Again, it is no longer necessary for individuals in the minority to have higher incomes than individuals in the majority to ensure a positive intraregional transfer in equilibrium. Proposition 3 no longer holds when non-myopic immobile individuals form the majority and, in general, whether or not an intraregional transfer is made depends on the parameters of the model.

Proposition 4 states that unless the minority has some enforcement mechanism to ensure participation in the transfer scheme, individuals in the minority have incentives to free ride. If a voluntary intraregional transfer is made, the majority adjusts public goods provision and all members of the minority benefit from this adjustment. Since a free rider cannot be excluded from enjoying the benefits associated with the change in the fiscal package, the voluntary transfer problem is similar to the problem of free-riding when there is voluntary provision of a public good. The above discussion shows that while regional minorities' incentives to make intraregional transfers may differ once migration is introduced, the minority still lacks the ability to exclude free riders from consuming the benefits of any transfer that is made. In other words, once a minority determines its optimal positive transfer, incentives to free ride are present and are not eliminated by the introduction of labour mobility into the model. Thus, proposition 4 continues to hold in the case with type A labour mobility.

In summary, since minorities cannot exclude free riders from consuming the benefits of voluntary intraregional transfers, free riding represents a serious threat to the ability of minorities to make welfare-improving transfers. Unless minorities have an effective enforcement mechanism to ensure participation, free riding results in an equilibrium with no intraregional transfers. In addition, if mobility is introduced into the model, it is difficult to determine under what conditions a non-myopic minority makes a positive intraregional transfer. In the remainder of this thesis, intraregional transfers are not considered. This is not to say that issues of minority lobbying and interest group politics are uninteresting; just that the potential for these activities in the context of the two region model with only two types of individuals presented here is limited.

IV.2 Incentives for Interregional Transfers

Section IV.1 examines the incentives for regional minorities to make intraregional transfers to individuals in the majority in an attempt to influence the majority's choice of fiscal package in the region. In this analysis, regional majorities are not permitted to make interregional transfers. A minority's incentives to make transfers are first examined when individuals are immobile and then reconsidered when type A individuals are mobile across regions. When labour is immobile, a necessary condition for a positive intraregional transfer is that individuals in the minority have higher income than individuals in the majority and that free riding and enforcement problems do not exist. In this case, if the minority chooses a positive transfer, all individuals in the region are better off. Once some labour mobility is permitted, the condition that minority income exceeds majority income is no longer necessary or sufficient for a positive income transfer when individuals are non-myopic. In this case, it is difficult to derive the general conditions under which a positive transfer or bribe is made. If, however, individuals are myopic with respect to the migration effects of their fiscal choices, then the conditions for a positive intraregional transfer are identical to the no mobility case. In the above analysis, if the minority is unorganized with no legislative or legal power to ensure mandatory participation, free riding may result in a zero intraregional transfer in equilibrium.

In this section, the analysis focuses on the incentives for regional majority governments to make voluntary interregional transfers to non-residents in a fiscal externality framework. Myers (1990), Burbidge and Myers (1994), and others also examine regional government incentives to make voluntary transfers but not in the context of diverse intraregional preferences and majority voting. As noted in the introduction to this chapter, this literature does not consider incentives for intraregional transfers. Thus, for purposes of comparison with these related models, the model developed below excludes intraregional transfers by regional minorities and focuses only on regional majorities' incentives to transfer income to non-residents.

Consider first the incentives for interregional transfers in a model where all individuals are immobile. Using the model developed in chapter III with the additional condition that all individuals are immobile, it is clear that neither region has an incentive to voluntarily give income away to non-residents. Since individuals do not have interregionally interdependent utility functions in this model and there are no migration links between regions, an income transfer is simply a type of foreign aid with no associated benefits. With the introduction of mobility for type A individuals, regions are linked by migration and there may be incentives for regional majorities, acting in their own self-interest, to voluntarily transfer income to non-residents.

Here, the model in chapter III is extended to consider regional governments' incentives to make interregional transfers when individuals are heterogeneous with respect to mobility costs and fiscal decisions are determined by majority voting. Rules for the provision of public goods and voluntary transfers are derived. In section IV.3, the migration equilibrium is characterized for alternative population configurations (i.e. characterized according to the identities of regional majorities). Section IV.4 concludes this chapter.

Individuals are assumed to be non-myopic since only in this case are agents aware that regional policy influences regional population through fiscally-induced migration. In addition to choosing the level of public goods provision, the regional majority in region i has an additional fiscal instrument and may choose to make a voluntary transfer to region j, given by TR_{ij}. As above, each majority is constrained to finance these transfers and expenditures on public goods with tax revenues raised by the uniform head tax, τ_i. Thus, the budget constraint for the majority in region i is:

$$G_i + TR_{ij} - TR_{ji} = \tau_i(L_i^A + L_i^B) \quad . \tag{IV.9}$$

Residents are assumed to share equally in any transfers made or received. The model assumes transfers are made directly to individuals.[47]

Since individuals, and therefore regional majorities, are non-myopic with respect to the effects of their fiscal choice on their population, the majority in each region takes into consideration the equal utilities condition:

$$U(x_1^A, G_1) = U(x_2^A, G_2) \quad . \tag{IV.10}$$

Individuals and regional majorities are assumed, however, to take as given the other region's fiscal choices. Assuming that type t individuals form the majority in region i, the majority chooses G_i and TR_{ij} to maximize the following objective function[48]:

$$\textit{maximize} \quad \mathfrak{L} = U(x_i^t, G_i) + \lambda\big(U(x_1^A, G_1) - U(x_2^A, G_2)\big),$$

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[47] This assumption is discussed further in section IV.3.

[48] Implicit in this formulation is the assumption that the choices of G_i and TR_{ij} leave the identity of a region's majority unchanged.

subject to the equations of the model and where $G_i \geq 0$, $TR_{ij} \geq 0$, $i=\{1,2\}$, and $t \in \{A,B\}$. The maximization problem for a type t majority in region 1 yields the following Kuhn Tucker conditions:

$$(IV.11) \qquad {}_1U_G^t - \frac{{}_1U_x^t}{L_1^A+L_1^B} + {}_1U_x^t\left(\frac{\partial x_1^t}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial G_1}\right) \leq 0\ ,\ G_1 \geq 0 \ and\ G_1\frac{\partial U}{\partial G_1} = 0\ ,$$

$$(IV.12) \qquad -\frac{{}_1U_x^t}{L_1^A+L_1^B} + {}_1U_x^t\left(\frac{\partial x_1^t}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial TR_{12}}\right) \leq 0,\ TR_{12} \geq 0 \ and\ TR_{12}\frac{\partial U}{\partial TR_{12}} = 0\ ,$$

and the maximization problem for a type m majority in region 2 yields:

$$(IV.13) \ {}_2U_G^m - \frac{{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m\left(\frac{\partial x_2^m}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial G_2}\right) \leq 0,\ G_2 \geq 0 \ and\ G_2\frac{\partial U}{\partial G_2} = 0 \quad .$$

and

$$(IV.14) \qquad -\frac{{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m\left(\frac{\partial x_2^m}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial TR_{21}}\right) \leq 0,\ TR_{21} \geq 0 \ and\ TR_{21}\frac{\partial U}{\partial TR_{21}} = 0\ .$$

The first two terms in equations (IV.11) and (IV.13) represent, for each region's majority, the direct marginal benefit and marginal cost of the public good, respectively. The third term represents the indirect utility effect from fiscally-induced migration with respect to the region's choice of public goods provision. The magnitude of fiscally-induced migration is given by the perceived migration responses, $\partial L_1^A/\partial G_1$ and $\partial L_1^A/\partial G_2$. The first term in both equations (IV.12) and (IV.14) is the marginal cost of each region's voluntary transfer. The second term represents the marginal benefit of the transfer or the indirect utility effect from fiscally-induced migration with respect to the region's choice of transfer. These migration responses represent the type A migration that region i's majority perceives it can generate by a small change in either its provision of the public good or its voluntary transfer.

Totally differentiating the equal utilities condition for type A individuals with respect to G_1, G_2, TR_{12}, TR_{21}, and L_1^A holding all other exogenous variables fixed, the perceived migration responses are[49]:

$$\text{(IV.15)} \qquad \frac{\partial L_1^A}{\partial G_1} = \frac{-\left({}_1U_G^A - \dfrac{{}_1U_x^A}{L_1^A + L_1^B} \right)}{{}_1U_x^A \dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \dfrac{\partial x_2^A}{\partial L_1^A}} ,$$

$$\text{(IV.16)} \qquad \frac{\partial L_1^A}{\partial G_2} = \frac{\left({}_2U_G^A - \dfrac{{}_2U_x^A}{L^A - L_1^A + L_2^B} \right)}{{}_1U_x^A \dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \dfrac{\partial x_2^A}{\partial L_1^A}} ,$$

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[49] Equations (IV.15) to (IV.18) are identical to those derived in Myers (1990) except for the inclusion of regional type B populations.

$$\frac{\partial L_1^A}{\partial TR_{12}} = \frac{\left(\frac{{}_1U_x^A}{L_1^A+L_1^B} + \frac{{}_2U_x^A}{L^A-L_1^A+L_2^B}\right)}{{}_1U_x^A\frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\frac{\partial x_2^A}{\partial L_1^A}} \quad , \tag{IV.17}$$

$$\frac{\partial L_1^A}{\partial TR_{21}} = \frac{-\left(\frac{{}_1U_x^A}{L_1^A+L_1^B} + \frac{{}_2U_x^A}{L^A-L_1^A+L_2^B}\right)}{{}_1U_x^A\frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\frac{\partial x_2^A}{\partial L_1^A}} \quad , \tag{IV.18}$$

where $\partial x_1^A/\partial L_1^A$ and $\partial x_2^A/\partial L_1^A$ are:

$$\frac{\partial x_1^A}{\partial L_1^A} = \frac{\partial\left(F_1^A + \frac{R_1-G_1-TR_{12}+TR_{21}}{L_1^A+L_1^B}\right)}{\partial L_1^A}$$

$$F_1^{AA} + \left(-\frac{F_1^{AA}L_1^A}{L_1^A+L_1^B} - \frac{R_1}{(L_1^A+L_1^B)^2}\right) + \frac{G_1}{(L_1^A+L_1^B)^2} + \frac{TR_{12}-TR_{21}}{(L_1^A+L_1^B)^2} \ ,$$

and

$$\frac{\partial x_2^A}{\partial L_1^A} = \frac{\partial\left(F_2^A + \dfrac{R_2+G_2-TR_{21}+TR_{12}}{L^A-L_1^A+L_2^B}\right)}{\partial L_1^A}$$

$$= -F_2^{AA} + \left(\frac{F_2^{AA}(L^A-L_1^A)}{L^A-L_1^A+L_2^B} + \frac{R_2}{(L^A-L_1^A+L_2^B)^2}\right) - \frac{G_2}{\left(L^A-L_1^A+L_2^B\right)^2} + \frac{TR_{12}-TR_{21}}{\left(L^A-L_1^A+L_2^B\right)^2}.$$

If stability of the migration equilibrium is imposed then the denominator in all migration response functions is negative. Since ${}_iU^i_G$ and ${}_iU^i_x$ are positive, the perceived migration responses to a change in transfer, $\partial L_1^A/\partial TR_{12}$ and $\partial L_1^A/\partial TR_{21}$, are negative and positive respectively. Each regional majority perceives that a small increase in its transfer to the other region decreases the mobile population in their own region.

Note the signs of both $\partial L_1^A/\partial TR_{12}$ and $\partial L_1^A/\partial TR_{21}$ are independent of the identity of the regional majority. In other words, if a region voluntarily transfers income to residents in another region, this initially increases the utility of all residents in the transfer-receiving region, including the utility of mobile residents. All else equal, this induces migration from the region making the transfer to the transfer-receiving region regardless of the identity of either majority.

The perceived migration responses, $\partial L_1^A/\partial G_1$ and $\partial L_1^A/\partial G_2$, are, however, dependent on regional majorities' identities. In particular, the sign of $\partial L_1^A/\partial G_1$ depends on the sign of the expression:

$$\left({}_iU_G^A - \frac{{}_iU_x^A}{L_i^A + L_i^B} \right) .$$

The region's perceived ability to influence migration of type A individuals depends on how the majority's optimal choice of public goods provision satisfies the mobile labour type's preferences. When a type A majority exists in region i, the perceived migration response equals zero since type A preferences for the public good are exactly satisfied in both regions. However, when type B individuals form the majority and type A and B individuals' incomes differ within a region, the level of the public good is either too high or too low relative to the level preferred by type A individuals. As a result:

$$\left({}_iU_G^A - \frac{{}_iU_x^A}{L_i^A + L_i^B} \right) \neq 0 \qquad ,$$

and consequently, $\partial L_i^A / \partial G_i$ is non-zero.

In the following section, the migration equilibrium with interregional transfers is characterized for alternative population configurations.

IV.3 Migration Equilibrium and Incentives for Interregional Transfers

The introduction of a regional transfer instrument has different implications for the migration equilibrium and for the welfare of mobile and immobile labour depending on the identity of the majority in each region which, in turn, depends on the model's parameters. Assuming that migration leaves the identities of regional majorities unchanged, majorities' incentives to make transfers and the migration equilibrium can, however, be characterized for alternative population configurations.

Mobile Majority in Both Regions

Propositions 5 and 6 are derived for the case where the mobile, type A individuals form the majority in both regions in the migration equilibrium with or without transfers.

Proposition 5.

If the mobile type forms the majority in both regions, the migration equilibrium is necessarily characterized by a net voluntary interregional transfer as long as regions are not perfectly symmetric.

Suppose the relative populations of type A and B labour are such that type A majorities are formed in both regions whether or not transfers are made in equilibrium. The equilibrium solutions to the model's five endogenous variables, L_1^A, G_1, G_2, TR_{12} and TR_{21}, are determined by the five equation system consisting of two Kuhn Tucker conditions for each region (equations (IV.11) to (IV.14)) and the equal utilities condition, equation (IV.10). Recall that the perceived migration responses, $\partial L_1^A/\partial G_1$ and $\partial L_1^A/\partial G_2$, equal zero when the mobile type forms the majority in both regions. Thus, a regional majority may, in this case, influence its population through voluntary transfers only. With some manipulation of equation (IV.11) we can show that $\partial U/\partial TR_{12} = -\partial U/\partial TR_{21}$. Suppose $\partial U/\partial TR_{12}$ and $\partial U/\partial TR_{21}$ are evaluated at the no-transfer equilibrium. This relationship implies that if one region desires to make a positive transfer, the other region desires to receive a transfer. Therefore, in any migration equilibrium where type A majorities exist in both regions and interregional transfers are possible, one region necessarily makes a positive transfer while the other region makes a zero transfer.[50] If regions are perfectly symmetric, the no-transfer equilibrium is characterized by equal-sized regions with identical fiscal packages. The preferred mobile population size for each region in this case is exactly one half of the available mobile labour. Since regions obtain their preferred populations in the no-transfer equilibrium, allowing voluntary transfers between regions leaves the equilibrium unaffected and the net interregional transfer in this special case equals zero.

Myers (1990) also shows that the migration equilibrium is necessarily characterized by a net voluntary transfer for the case where all individuals are perfectly mobile and identical.[51] Here, a similar result is shown to hold for the case where regional majorities are perfectly mobile and regional minorities are perfectly immobile. The existence of the same type majority in both regions can be interpreted as regional authorities having the "same" implicit preferences for redistribution. Burbidge and Myers (1994) show that the Nash equilibrium is efficient when preferences for redistribution are the same and that voluntary transfers are not necessarily a feature of an efficient equilibrium. As is shown in this model, when regions are not symmetric, regional preferences are the same and the mobile labour type forms the majority in both regions, the migration equilibrium is not efficient although the equilibrium necessarily involves voluntary transfers.

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[50] Note that one region actually prefers a negative transfer. However, since this regional majority can only transfer income out of the region it chooses to set the transfer at its smallest possible level, zero.

[51] Krelove (1988) also derives a similar result.

Proposition 6.

When a mobile majority exists in both regions, the voluntary transfer in the migration equilibrium does not ensure an optimal allocation of the mobile population.

In the Myers model the voluntary interregional transfer ensures that the regional distribution of population is efficient (i.e. the marginal net social benefit of population is equalized across regions).[52] In contrast, allowing regional majorities an instrument to make positive income transfers in the model presented here does not ensure that the mobile population is optimally distributed. To see this, it is necessary to derive the net interregional transfer, $(TR_{12}-TR_{21})$, that is made in the Nash equilibrium. The expressions for $\partial x_1^A/\partial L_1^A$, $\partial x_2^A/\partial L_1^A$, $\partial L_1^A/\partial TR_{12}$ and $\partial L_1^A/\partial TR_{21}$ are first substituted into the Kuhn Tucker conditions for TR_{12} and TR_{21}. Equating equations (IV.11) and (IV.13) and rearranging yields:

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[52] In addition, in Myers' model the transfer equilibrium is characterized by optimal public goods provision (i.e. public goods are provided at the Samuelson level). The introduction of individual heterogeneity and majority voting implies that even in the transfer world the level of public good provision in each region is sub-optimal relative to the level indicated by the Samuelson condition for the existing distribution of income.

$$TR_{12} - TR_{21} = \left(\frac{(L_1^A + L_1^B)(L^A - L_1^A + L_2^B)}{L^A + L_1^B + L_2^B} \right) \times \tag{IV.19}$$

$$\left[\left(F_2^{AA} L_2^B - \frac{R_2 - G_2}{L^A - L_1^A + L_2^B} \right) - \left(F_1^{AA} L_1^B - \frac{R_1 - G_1}{L_1^A + L_1^B} \right) \right] .$$

Equation (IV.19) ensures that the marginal benefit of an additional migrant to the type A majority is equated across regions. In region i, the marginal benefit of an additional migrant to the mobile majority consists of three effects. To isolate these three effects, $F_i^{AA} L_i^B$ in equation (IV.19) is replaced with:

$$F_i^{AA} - \frac{F_i^{AA} L_i^A}{L_i^A + L_i^B} .$$

F_i^{AA} captures the effect of a change in region i's type A population on the marginal product of type A labour in the region. The effect on an additional migrant on per capita rents is given as:

$$\frac{-F_i^{AA} L_i^A}{L_i^A + L_i^B} - \frac{R_i}{L_i^A + L_i^B} .$$

The first term measures the per capita effect of a type A migrant on total rents. Since the migrant is, however, entitled to an equal share of the region's rents, a rent sharing externality equal to $R_i/(L_i^A + L_i^B)$ is imposed on existing residents. Finally, the term, $G_i/(L_i^A + L_i^B)$, in equation (IV.19) measures the fiscal or cost sharing externality and represents the migrant's contribution to total tax revenues in region i.

Equation (IV.19) is analogous to the net voluntary interregional transfer made by Nash competing regional authorities in Myers (1990) except for the term:

$$F_2^{AA}L_2^{B} - F_1^{AA}L_1^{B} .$$

In contrast to the assumption of heterogenous individuals made here, Myers assumes all individuals in the economy are identical and perfectly mobile. Myers' net interregional transfer can be viewed then as a special case of equation (IV.19) (i.e. when $L_1^B = L_2^B = 0$). In Myers' model, the loss in income for type A individuals resulting from a decrease in the marginal product of type A labour just equals the increase in total income from rents. Since these effects cancel, the marginal benefit of an additional migrant includes this individual's contribution to total tax revenues minus the rent sharing externality. In contrast, with heterogeneity, uniform taxation, and uniform rent sharing, type B individuals share in any increase in rents resulting from in-migration. Therefore, the income loss for type A individuals from a reduction in their marginal product is not completely offset by an increase in income from rents.

The transfer required to restore efficiency in the allocation of labour can be derived in an identical manner to that found in Myers (1990) and earlier in Hartwick (1980) but taking into account the presence of immobile type B populations in each region. The optimal distribution of mobile population in this case is given by the first order condition to the planner's problem:

(IV.20) $$\left(F_i^A - x_i^A\right) = \left(F_j^A - x_j^A\right)$$

derived as equation (III.23) in chapter III. Substituting equations (III.6) and (III.8) into equation (IV.20) yields:

$$\frac{G_i + \left(TR_{ij} - TR_{ji}\right) - R_i}{L_i^A + L_i^B} = \frac{G_j - \left(TR_{ij} - TR_{ji}\right) - R_j}{L^A - L_i^A + L_j^B} .$$

The socially optimal distribution of population ensures that the net social benefit of an additional migrant is equated across regions and requires that per capita taxes net of rent shares be equal in both regions. The optimal transfer, $(TR_{ij}-TR_{ji})^*$, is solved by rearranging the above to obtain:

(IV.21) $$\left(TR_{ij} - TR_{ji}\right)^* = \left(\frac{\left(L_i^A + L_i^B\right)\left(L^A - L_i^A + L_j^B\right)}{\left(L^A + L_i^B + L_j^B\right)}\right) \times \left[\left(\frac{G_j}{L^A - L_i^A + L_j^B} - \frac{R_j}{L^A - L_i^A + L_j^B}\right) - \left(\frac{G_i}{L_i^A + L_i^B} - \frac{R_i}{L_i^A + L_i^B}\right)\right] .$$

In equation (IV.19), the net transfer equalizes across regions the net marginal benefit of an additional migrant to the mobile majority while the optimal transfer equalizes the net marginal social benefit of an additional migrant across regions. Assuming i=1 and j=2, a comparison of equation (IV.21) with equation (IV.19) shows that the net voluntary transfer in the migration equilibrium differs from the transfer required for a social optimum unless:

$$F_2^{AA}L_2^B - F_1^{AA}L_1^B = 0 \ .$$

These additional terms are found in equation (IV.19) because the type A majority includes the private effect of fiscally-induced migration on its marginal product. When determining the optimal transfer, this private effect is not included. In the case where individuals are identical, as in Myers (1990), and individuals own an equal share of the economy's land, these private effects also drop out giving the result that the voluntary transfer is identical to the socially optimal transfer. In the model presented here, each type A majority includes the change in their marginal product resulting from migration, generating a net voluntary transfer different from the optimal transfer.[53] Thus, the inefficiency result stems from the fact that fiscal decisions are determined by majority voting and therefore includes only the costs and benefits of these fiscal decisions to a subset of individuals in the region. The costs and benefits of majority decisions on individuals in the minority are excluded from majority decision-making. As a result, public goods provision and the distribution of mobile labour in equilibrium with majority voting generally differ from the social optimum. The introduction of private considerations into regional government decision-making means that a majority voting, migration equilibrium fails to achieve a Pareto optimal allocation, as derived from the social planner's problem, demonstrating proposition 6.[54]

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[53] While the assumption of uniform regional rent sharing influences the magnitude of the distortion between the equilibrium and optimal transfers, the inefficiency result is not driven by this assumption. In particular, the inefficiency result is also found under alternative land ownership structures. It can be shown that the voluntary transfer made in the migration equilibrium differs from the optimal transfer when type A individuals are assumed to own an equal share of the economy's land or when immobile residents own all the land within a region's borders.

Immobile Majority in Both Regions

Proposition 7 characterizes the migration equilibrium when interregional transfers are possible for the case where type B individuals form the majority in both regions.

Proposition 7.

If the immobile type forms the majority in both regions, voluntary transfers may or may not occur in equilibrium.

Suppose the immobile population in each region is sufficiently large relative to the regions' type A populations so that in both the no transfer and transfer equilibria type B individuals form the majority. The equilibrium solutions to L_1^A, G_1, G_2, TR_{12} and TR_{21} are determined by the two Kuhn Tucker conditions for each region plus the equal utilities condition for type A individuals. Note that an immobile majority may influence its population through both its choice of public goods provision and voluntary transfer. Like above, the same type majority in both regions is analogous to regions having the same preferences for implicit redistribution. It is no longer true, however, when immobile individuals form the majority in both regions and transfers are allowed, that a net voluntary transfer necessarily occurs in equilibrium.

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[54] By the same reasoning, voluntary transfers made in this model regardless of the identity of regional majorities generally fails to achieve an optimal population allocation.

Necessary Condition for a Positive Net Interregional Transfer

The condition necessary but not sufficient to ensure that the migration equilibrium is characterized by a positive net interregional transfer is that $\partial x_i^B/\partial L_i^A < 0$ in at least one region, or that private good consumption for a type B individual increases with decreases in the region's mobile population. The term, $\partial x_i^B/\partial L_i^A$, is positive when the cost sharing and total rent effects outweigh the negative rent sharing effect in both regions. To see this, consider first the case where this necessary condition is not met in any region so that $\partial x_i^B/\partial L_i^A > 0$ for $i = \{1,2\}$. Regional incentives to choose a voluntary transfer are examined starting from the migration equilibrium where no voluntary transfers are permitted. Evaluating the Kuhn Tucker condition for a type B majority's choice of transfer in region i when transfers equal zero and $\partial x_i^B/\partial L_i^A > 0$, the indirect utility effect of fiscally-induced migration is positive and $\partial U/\partial TR_{ij}$ is negative. In this case, regional majorities believe the utility of type B residents can be increased by increasing the region's type A population. This indicates that the type B majority in each region chooses a zero transfer.

Under these conditions, no transfers are made and the transfer and no-transfer equilibria are identical. Each non-myopic regional majority can still influence their region's mobile population through its choice of public good. The incentives of non-myopic regional majorities to use the fiscal package to attract type A labour are identical to those described in chapter III. As in the case where the mobile type forms the majority in both regions, there is nothing in the model that ensures that the distribution of labour in equilibrium is optimal. This discussion shows under what circumstances regional majorities choose not to make voluntary transfers in equilibrium, demonstrating part of proposition 7. Regional majorities may have incentives to make positive interregional transfers only if the necessary condition, $\partial x_i^B/\partial L_i^A$, is satisfied for at least one region.

Sufficient Condition for a Positive Net Interregional Transfer

The sufficient condition for region i to make a positive transfer is that the marginal benefit of the transfer exceeds its marginal cost or $\partial U(x_i^B,G_i)/\partial TR_{ij} > 0$ when evaluated at the no-transfer equilibrium. As long as this condition is satisfied in at least one region, the migration equilibrium is characterized by a positive net voluntary interregional transfer. Consider an example. Suppose $\partial x_1^B/\partial L_1^A < 0$ and $\partial x_2^B/\partial L_2^A > 0$. Under these assumptions, the majority in region 1 prefers a smaller type A population while region 2's majority prefers more mobile individuals. Since a voluntary transfer of income out of the region encourages outmigration from that region, region 2's majority chooses a zero transfer. The type B majority in region 1 chooses a positive transfer only if the marginal cost of the transfer is lower than the marginal benefit of the transfer, when evaluated at the no-transfer equilibrium.

Assuming these conditions are satisfied, the migration equilibrium is characterized by a positive net interregional transfer, demonstrating the second part of proposition 7. With this transfer, the majority in region 1 purchases a smaller mobile population which it prefers. Region 2 has a larger type A population relative to the no-transfer equilibrium, a situation preferred by the region's immobile majority. Only in this particular case, is it possible for all type B individuals to have higher utility in the transfer equilibrium.

The overall effect on the utility of type A individuals is ambiguous. Since region 2's public goods provision is closer to type A's preferred level and all residents receive a share of the income transfer, the utility of type A individuals in region 2 tends to increase relative to the no-transfer equilibrium. The marginal product of type A labour in region 2 is, however, lower in the transfer equilibrium, offsetting the positive utility effects for mobile individuals. While the overall effect on type A utility is ambiguous, the equal utilities condition ensures that if utility for type A individuals is higher in one region in the transfer equilibrium, utility for all type A individuals is higher. For example, if the utility for type A individuals in region 2 is higher in the transfer equilibrium, then all mobile individuals are better off relative to the no-transfer equilibrium. In this case, it is possible that the introduction of voluntary transfers can lead to higher utility for all individuals in the economy.

For this special case to arise, region 1 must choose to make a positive transfer while region 2 chooses a zero transfer and the conditions, $\partial x_1^B/\partial L_1^A < 0$ and $\partial x_2^B/\partial L_2^A > 0$, must also be satisfied. The latter two conditions suggest that significant regional disparity is required to ensure higher utility for all immobile individuals in a world with voluntary transfers. With $\partial x_1^B/\partial L_1^A < 0$, the negative rent sharing effect associated with an additional mobile individual is larger than the combined positive income effects from cost-sharing and the increase in total rents in region 1. In the above example, region 1 chooses a positive transfer to purchase a smaller type A population. In contrast, when $\partial x_2^B/\partial L_2^A > 0$, the positive effects associated with an additional migrant outweigh the negative rent sharing effect. Therefore, the type B majority in region 2 prefers a larger mobile population. If regions are symmetric in all respects except for regional land endowments, these conditions suggest that there must be a significant disparity between these endowments of land. Since the marginal product of land increases with increases in type A labour, but at a diminishing rate, the above conditions suggest that region 1 has a relatively small endowment of land while region 2 has a relatively large land endowment.

For completeness, consider the case where the necessary condition, $\partial x_i^B/\partial L_i^A < 0$, is satisfied for both regions. Here, both regional majorities prefer a smaller mobile population. In this case, neither region may choose to make a positive transfer in the migration equilibrium or one or both regions may choose a positive transfer depending on the relative marginal cost and benefit of making a transfer in either region. For example, suppose that $\partial U(x_1^B, G_1)/\partial TR_{12} > 0$ and $\partial U(x_2^B, G_2)/\partial TR_{21} < 0$ when evaluated at the no-transfer equilibrium. Since $\partial x_i^B/\partial L_i^A < 0$ for $i = \{1,2\}$ neither regional majority prefers a larger type A population as compared to the no-transfer equilibrium. Regional majorities continue to choose the level of public good in the region taking into account the effect this choice has on migration incentives of mobile individuals. In this case, since the benefits of a voluntary transfer exceed the costs in region 1, the type B majority in region 1 chooses to encourage out-migration by voluntarily transferring income to individuals in region 2.

In region 2, the costs of a voluntary transfer exceed the benefits and therefore region 2 chooses a zero transfer. In equilibrium, a net voluntary interregional transfer from region 1 to region 2 occurs.

Type B individuals in region 1 are better off relative to the no-transfer equilibrium given the lower type A population while type B individuals in region 2 are worse off. Recall that the regional majority that successfully decreases its mobile population relative to the no-transfer equilibrium increases the utility of its type B members. Since the total type A population to the economy is fixed, the region that reduces its share of type A labour does so at the expense of the other region.

Acceptance of the Transfer

Since type B individuals in the transfer-receiving region are worse off relative to the no-transfer equilibrium, it is important to consider under what conditions a region would accept such a transfer. Suppose that regional majorities tax their own residents in order to make a transfer directly to non-residents. While the majority in region j believes utility can be increased by having a smaller mobile population, self-interested residents, including those in the majority, do not decline the income transfer from region i. If transfers are, however, made directly to the regional government which is then suppose to distribute the transfer to its residents, it is less clear why a regional majority would accept a transfer when this action works to increase the region's mobile population and decrease the utility of individuals in the majority. In the context of a small number of jurisdictions, such myopic behaviour is indeed difficult to justify and it would be expected that the majority would decline the transfer and the equilibrium would then revert to the no-transfer case.

Note that this problem does not arise when non-myopic regional majorities choose only the level of public goods provision as is the case in Chapter III. In this case, competition for more or less mobile labour occurs through regional public goods provision. In contrast, with the introduction of voluntary transfers, direct interaction between regions is introduced, making it difficult to rationalize why a regional government accepts a welfare-reducing voluntary transfer from another region. Thus, without demonstrating this formally, it seems clear that if transfers are made to regional governments, rational regional majorities would decline welfare-reducing transfers. For these reasons, transfers must be made directly to persons rather than regional governments, if such transfers are to occur.[55]. This result suggests that interpersonal transfers are not equivalent to transfers between governments.

The analysis is similar for the case where both regions desire to make a positive transfer in equilibrium. In this case, only if transfers are made directly to non-residents and if regions are not perfectly symmetric, is the migration equilibrium necessarily characterized by a net interregional transfer.[56]. Suppose region i makes a larger transfer than region j. Although the type B majority in region j chooses to make a positive transfer, this transfer is smaller than region i's voluntary transfer.

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[55] Alternatives to the Nash behaviourial assumption that allow for recognition of strategic interdependence by regional majorities represent interesting possibilities for future consideration.

[56] If regions are perfectly symmetric, regional transfers cancel each other out and the migration equilibrium is characterized by a zero net interregional transfer.

Thus, in equilibrium, region j receives a positive interregional transfer and a larger share of the mobile population. As a consequence, the type B majority in region j is worse off relative to the no transfer world, an undesirable outcome for type B individuals in this region.

To conclude, if the immobile labour type forms the majority in both regions, the migration equilibrium may or may not be characterized by voluntary transfers. In addition, even if a net voluntary interregional transfer is made in equilibrium, there is no reason that the resulting distribution of the mobile population in a migration equilibrium with or without transfers is optimal as regional majorities have no utility linkages. Even if all individuals are mobile and these utility linkages are present, there is no reason to expect that the transfers made in a majority voting equilibrium achieve an optimal distribution of population. Since regional majorities take into account only their own utility when choosing their fiscal package, any social benefits from more or less population are not taken into account. Unless all individuals in the economy are identical as in Myers (1990), voluntary transfers in this case do not achieve an optimal allocation of labour.

Immobile Majority in Region 1 and a Mobile Majority in Region 2

Proposition 8 derived below characterizes the migration equilibrium when the identities of the regional majorities differ.

Proposition 8.

When the identity of the regional majorities differ, voluntary transfers may or may not occur in equilibrium and, in general, the distribution of mobile labour is suboptimal.

With majorities of different types in the two regions, regional preferences for implicit redistribution differ. In Burbidge and Myers (1994) when regional preferences differ, the equilibrium distribution of population is suboptimal although voluntary transfers generally occur in equilibrium. Similar results are found in this model with majority voting and asymmetric mobility costs. Consider the case where region 1 has a type B majority while region 2 has a type A majority. The analysis for this population configuration is similar to the case where the immobile labour type forms the majority in both regions so it is not repeated in detail here. If a transfer occurs in equilibrium, then the net interregional transfer is implicitly defined by setting each regional first order condition with respect to its choice of transfer to zero and equating the two expressions.

Here, the type B majority has two instruments, G_1 and TR_{12}, at its disposal to achieve its objectives. The type A majority, however, can influence migration directly only by its choice of voluntary transfer since its perceived migration response associated with public goods provision is zero. Like the case where the immobile type forms the majority in both regions, regional majorities may desire more or less mobile population depending on the sign of $\partial x_i^t/\partial L_i^A$ where t indicates the identity of the majority in region i. The necessary conditions for both regions to make voluntary transfers are $\partial x_1^B/\partial L_1^A<0$ and $\partial x_2^A/\partial L_2^A<0$. These are necessary but not sufficient conditions. A regional majority chooses a positive transfer only if the marginal benefit of the transfer exceeds its marginal cost. Therefore, transfers may be present in equilibrium when the identity of the regional majorities differ. In addition, there is no reason to believe that voluntary transfers made in equilibrium achieve the optimal distribution of mobile labour or ensure that per capita taxes net of rent shares are equated across regions. Since majority decision-making excludes the costs and benefits of an additional migrant to the regional minority, it is unlikely that an optimal distribution of population is achieved in the decentralized majority voting equilibrium.

IV.4 Conclusions

This chapter examines regional incentives to make voluntary transfers when regional fiscal decisions are made by majority voting. This analysis shows that incentives to make both intraregional or interregional transfers depend on the identity of the majority in each region and that the migration equilibrium generally results in a suboptimal distribution of mobile labour. The model developed in chapter III is extended first to consider regional minorities' incentives to make voluntary *intraregional transfers* to individuals in the majority, an issue that has not been explored in the fiscal externality context. Since intraregional preferences for the fiscal package are diverse, the majority's choice of public goods provision fails to satisfy the preferences of individuals in the minority. Consequently, a minority may have an incentive to transfer income to the majority in an attempt to influence the majority's choice.

The model shows that if all individuals are immobile, a region's minority has an incentive to make a positive intraregional transfer to the majority only if individuals in the minority have higher incomes than majority members. If this condition is not satisfied and the minority prefers less of the public good than that provided by the majority, then the majority's promise to lower public goods provision in exchange for an income transfer is not credible. In this case, the ability to make intraregional transfers serves as a mechanism by which the constraint of uniform taxation can be relaxed as higher income individuals in the minority voluntarily agree to pay higher taxes. A proportional income tax is not a substitute, however, for uniform taxation and intraregional transfers since, with a proportional tax, minority members have no lever by which to influence the majority's fiscal choices.

Once labour mobility is introduced, it is necessary to determine whether individuals are myopic or non-myopic with respect to the migration effects of their fiscal choices. If individuals are myopic, minority and majority decision rules are identical to the no mobility case. In this case, a positive intraregional transfer occurs in region i in equilibrium only if the relative incomes condition described above is satisfied. When individuals are non-myopic, the relative incomes condition is no longer necessary or sufficient for the existence of positive intraregional transfers. In general, with non-myopic behaviour, regional minorities may make intraregional transfers if the positive benefits associated with changing public goods provision in the region, or the positive income benefits associated with a transfer-induced change in the region's mobile population or the positive benefits associated with both these effects exceed the marginal costs of making a transfer.

The results with or without labour mobility are derived for the case where there are no free rider or enforcement problems. Unless regional minorities have some mechanism to enforce participation in the transfer scheme or some way of excluding free riders from consuming the benefits of an intraregional transfer, free riding may preclude the possibility of intraregional transfers in equilibrium.

The incentives for regional majorities to make *interregional transfers*, or income transfers to non-residents, are also examined by extending the model developed in chapter III for the case where type A labour is mobile. For purposes of comparison with the related literature on this issue, intraregional transfers are not considered when examining regional governments' incentives for interregional transfers. The analysis shows that voluntary transfers necessarily occur in the migration equilibrium only when the mobile type forms the majority in both regions. Although the force of incentive equivalence ensures that voluntary transfers exist in equilibrium when both regions have a type A majority, a majority voting rule in the presence of intraregional diversity implies a type of decision-making externality. Since the majority does not take into account the benefits or costs of government fiscal decisions to individuals in the minority, the net interregional transfer resulting from majority decision-making fails to achieve an optimal allocation of mobile labour. The model developed here shows that voluntary transfers may or may not exist in equilibrium when the immobile type forms the majority in at least one region and the migration equilibrium is generally suboptimal in this case.

The analysis demonstrates that interregional transfers to persons are not identical to interregional transfers between governments and can lead to different outcomes with respect to regional public goods provision and the equilibrium distribution of labour and output. In particular, voluntary interregional transfers if made to governments are accepted only if individuals in the majority are made better off by the transfer. If, on the other hand, transfers are made to individuals, individuals would accept the transfer and the regional majority could be made worse off.

These results can be contrasted with Myers (1990) where a positive net interregional transfer sufficient to achieve an optimal distribution of population necessarily occurs in the migration equilibrium when individuals are identical and perfectly mobile. In his model, public goods are provided according to the optimal Samuelson condition and, since individuals are identical, non-myopic government decision-making does not impose any externalities. In contrast, in this model, majority voting results in a suboptimal level of public goods provision and, while voluntary transfers may occur in equilibrium, these transfers are generally insufficient to restore an optimal allocation of mobile labour since the externalities of majority decision-making are not incorporated into regional government decisions.

The analysis in this chapter is also closely related to Burbidge and Myers (1994) in that regional preferences for redistribution are implicitly defined by an exogenously imposed collective choice mechanism, majority voting in this model. These preferences depend on the composition of a region's population and the identity of each regional majority. Burbidge and Myers (1994) show that when regional preferences for redistribution are diverse and perfectly mobile individuals differ with respect to productivity and preferences, the Nash equilibrium results in an inefficient distribution of population. Voluntary transfers may occur in this equilibrium. When regional preferences are the same, the Nash equilibrium is efficient but voluntary transfers are not necessarily present in equilibrium.

In the model here, a specific form of preference for redistribution is imposed when a majority voting rule is adopted and an asymmetry in individual mobility is introduced. When regional preferences are the same (i.e. the same labour type forms the majority in both regions) the migration equilibrium is generally suboptimal and, only in the case where the mobile individuals form the majority in both regions, is the equilibrium necessarily characterized by voluntary transfers. Thus, the efficiency result of Burbidge and Myers (1994) is driven by the assumption of perfect mobility and the fact that public goods provision in the model is optimal. As in Burbidge and Myers (1994) when preferences differ, the migration equilibrium continues to be inefficient and voluntary transfers may or may not be present.

The importance of the assumptions regarding mobility in this model should not be understated. The model could be extended to allow for limited or costless mobility for type B individuals. In fact, for greater comparability with Burbidge and Myers (1994), the model should be extended to allow for costless mobility for type B individuals. This extension is likely to have interesting implications for regional majorities' incentives to make transfers given the increased significance of the endogeneity of the regional majority and hence the regional authority's objective function. However, since majority decision-making does not take into account the effects of its fiscal decisions on the utility of mobile individuals in the minority, it is unlikely that voluntary interregional transfers will restore the social optimum. In addition, alternatives to the Nash assumption and the possibility of declining a transfer are interesting and challenging extensions to explore in the future.

Chapter V: Majority Voting, Uncertainty and Constitutional Choice

V.1 Production Uncertainty and Risk Averse Individuals

The preceding chapters examine local public goods provision and the migration equilibria when regional government decisions are made by majority voting and individuals are heterogeneous with respect to their mobility and productivity. The model in chapter III shows that both local public goods provision and the migration equilibria are dependent on whether or not regional majorities are myopic.[57] The incentives for non-myopic regional majorities to make voluntary transfers given majority voting are investigated in chapter IV. The analysis in that chapter shows that the identity of the majority influences whether the migration equilibrium is necessarily characterized by voluntary interregional transfers. The level of transfers and efficiency in the allocation of mobile labour are also influenced by the identity of each regional majority. In several cases, the transfer necessary to achieve an optimal allocation of mobile labour is derived and compared to the transfer that emerges in a majority voting migration equilibrium. In addition, the model demonstrates that, under some conditions, regional minorities have incentives to make intraregional transfers to the region's majority in order to influence the majority's choice of fiscal package or migration into the region.

The central conclusion to emerge from the recent contributions of Myers (1990), Mansoorian and Myers (1993), and Burbidge and Myers (1994) is that regional governments may make voluntary interregional transfers in equilibrium but, in general, these transfers do not ensure an optimal allocation of labour. Consequently, centrally-coerced transfers are required to restore the social optimum. There is little in the structure of these models or the model developed in chapters III and IV to rationalize the existence of a central authority with the powers necessary to carry out these transfers. It is also unclear why regions or individuals in these models would willingly accept the intervention of this external authority. In other words, why would regions participate in a federation with a central authority that makes interregional transfers?

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[57] In the models of Myers (1990) and Burbidge and Myers (1994) the problem is viewed as stemming from misspecified or inappropriately assigned policy instruments available to regional authorities rather than from government or individual myopia.

In this chapter, the basic model developed in chapters III and IV is extended by introducing uncertainty to investigate the incentives of regional authorities to agree to some interregional transfer or insurance scheme. The idea here is that regional majorities comprised of risk averse individuals face uncertainty and may choose to adopt a constitution that specifies insurance in the form of centrally-imposed taxes and transfers. Insurance of this nature is similar to the social insurance rationale for interregional transfers proposed in Boadway (1992). Thus, the model explores the hypothesis that uncertainty and risk aversion can lead to the adoption of a constitution as a form of social insurance, and that this constitution creates a federal government with "national interests" which coexists with regional governments with regional interests.

This model builds on both the fiscal externality and optimal design literatures discussed in chapter II. In particular, the contractarian models of constitutional design focus on the effects of risk aversion and uncertainty on the type of constitutional design likely to be adopted. The model developed in this chapter furthers this research by introducing uncertainty and risk aversion into a fiscal externality framework to examine constitutional choice. In addition, the model builds on the notion of social insurance developed in Boadway (1992). Boadway views social insurance as insurance against being "unlucky at birth" or other such characteristics that lie beyond the control of the individual. Boadway argues that since private insurance typically must be purchased before the insured event occurs, and since individuals lack sufficient capital at birth to purchase the necessary insurance, there is a market failure. This provides a rationale for publicly provided social insurance by the government after the fact.

In the model developed in previous chapters, there is no need for insurance since the model is static with no uncertainty. To investigate an insurance rationale for interregional transfers, some form of uncertainty must therefore be present. This uncertainty can arise for a number of reasons including production and population shocks and uncertain growth. Here, uncertainty is introduced into the basic model in the form of a regional production shock. In the Canadian context, for example, regional governments face uncertainty with respect to the tax revenues they raise and, therefore, the public services they provide. Provinces also have diverse economies. Alberta, for example, relies to a large extent on its natural resource base while Ontario and Quebec have manufacturing-based economies. Given these differences, production shocks are likely to be regionally differentiated.

The introduction of such a production shock combined with the assumptions that individuals face asymmetric mobility costs (over which they have no control) means that some individuals may have the misfortune of residing in a fiscally poor region with no hope of migrating to a richer region. It is therefore possible in this model for individuals to be unlucky at birth. Private insurance for such an occurrence is unlikely to be available for the same reasons as espoused in Boadway (1992). Individuals in this model have no income at the time of constitutional negotiations and before the state of the world is known. Therefore, even if private insurance were available before the production shock is revealed, individuals have no funds with which to purchase insurance. Hence, there is a market failure. For these reasons, private insurance is assumed to be unavailable in this model. If there is to be any insurance for being "unlucky at birth", this insurance must be publicly provided.

The model is structured as a sequential choice problem. Initially individuals are assumed to face uncertainty with respect to production in the region. Given this uncertainty, individuals compare their expected utility under alternative constitutional arrangements and rank all constitutions relative to the no constitution outcome in expected utility terms. The majority government in each region adopts the ranking of the individual type that forms the majority, and given this ranking, regional majorities vote for their preferred constitution. If a particular arrangement receives the unanimous consent of all regional majorities, this constitution is adopted and assumed to be binding in any subsequent migration equilibrium. Once a choice has been made (some constitution or no constitution is chosen) the production shock is revealed and the optimal choices of individuals, regional majorities, and the federal government are determined simultaneously. Given these optimal choices, the migration equilibrium can then be characterized.

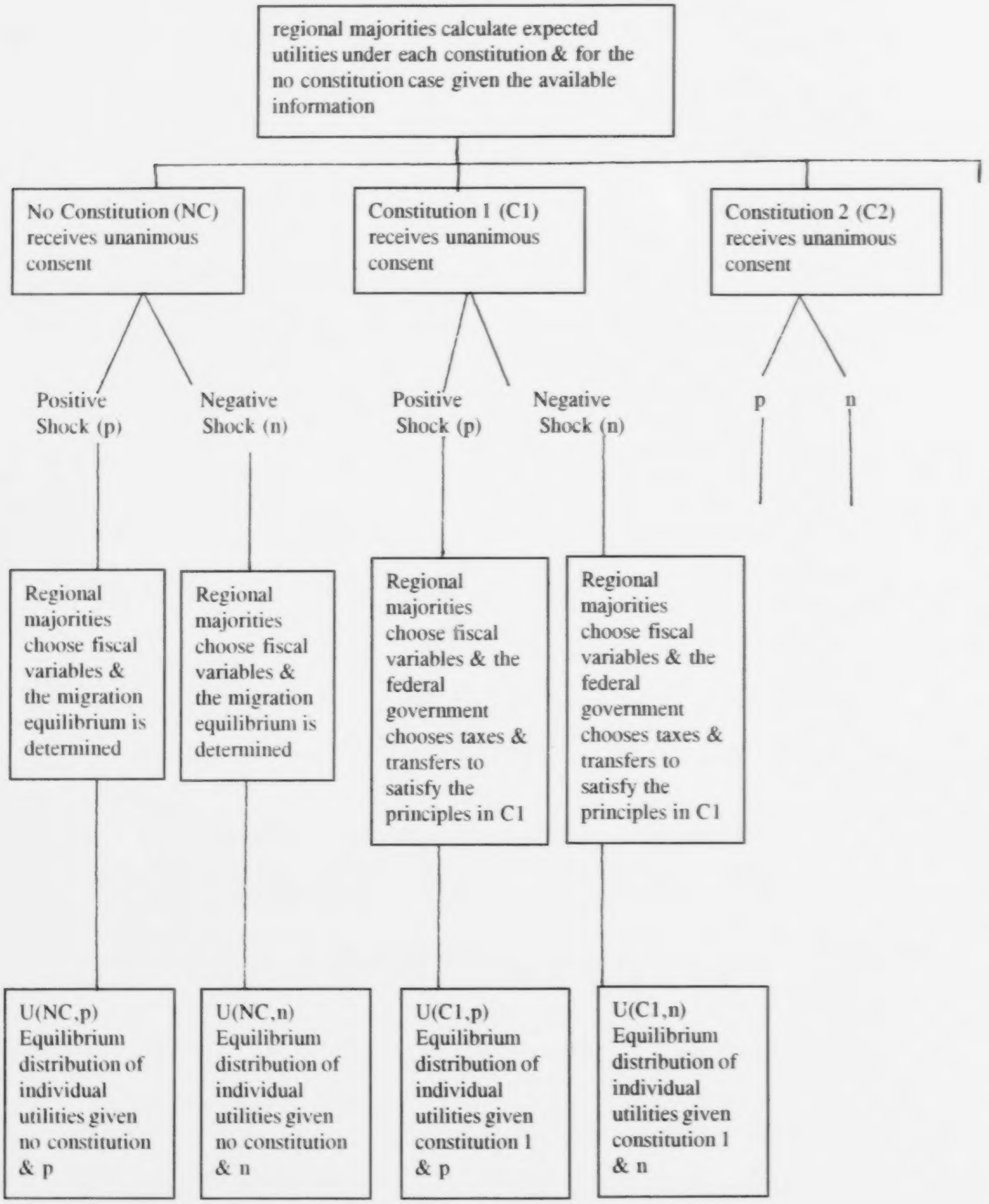
The model can also examine the influence of the availability of information on constitutional choices. For example, in addition to production uncertainty, individuals may not know with certainty their region of residence or their labour type. With the assumptions concerning mobility costs, uncertainty with respect to an individual's region of residence affects the immobile, type B individuals only. If individuals are uncertain as to their labour type, then all individuals are identical at the time of constitutional negotiations. By varying the amount of information individuals have regarding their region of residence or their labour type, we can affect the probabilities individuals and regional majorities use to calculate their expected utilities at the time of constitutional negotiations.

The sequence of decision-making in the model is illustrated in figure V.1. Before the production shock is known, individuals calculate their expected utility under each alternative constitution and in the absence of any constitution given the information available at the time. Regional majorities, as participants to the constitutional negotiations, use these rankings to vote for their preferred constitution. Only if a particular arrangement receives unanimous consent by regional majorities is this constitution adopted. If none of the constitutional options receives unanimous consent, then no constitution is adopted. Figure V.1 shows the different paths the economy takes when no constitution is adopted and for the case where constitution C1 is chosen at the time of constitutional decision-making. In reality, a separate branch would be required for all other potential constitutions, like constitution 2, 3 and so on, to illustrate all possible paths to a migration equilibrium.

Once the constitutional choice is determined, and a particular branch chosen, nature reveals the production shock to be positive or negative. Given the production shock and the binding constitutional choice, regional majorities optimally choose their fiscal package and, if a constitution is adopted, a federal government simultaneously chooses its tax and transfer variables according to the constitution and the migration equilibrium is determined. There is a unique distribution of utilities associated with each possible migration equilibrium. For example, in figure V.1, U(C1,p) represents the equilibrium utility distribution when constitution C1 is unanimously adopted and the production shock is positive. Similarly, U(NC,n) denotes the equilibrium utility distribution when no constitution is adopted and the production shock is negative. Note that at the time of constitutional choice, individuals and regional majorities solve for each possible migration equilibrium and use the information on the equilibrium utility distributions to calculate their expected utilities under each constitution.

Formally, the model is solved by first characterizing all possible migration equilibria; that is finding a separate equilibrium for each value of the production shock and for each possible constitution. Using this information, each individual's

Figure V.1: Sequence of Decision-making


regional majorities calculate expected utilities under each constitution & for the no constitution case given the available information
No Constitution (NC) receives unanimous consent
Constitution 1 (C1) receives unanimous consent
Constitution 2 (C2) receives unanimous consent
Positive Shock (p)
Negative Shock (n)
Positive Shock (p)
Negative Shock (n)
p
n
Regional majorities choose fiscal variables & the migration equilibrium is determined
Regional majorities choose fiscal variables & the migration equilibrium is determined
Regional majorities choose fiscal variables & the federal government chooses taxes & transfers to satisfy the principles in C1
Regional majorities choose fiscal variables & the federal government chooses taxes & transfers to satisfy the principles in C1
U(NC,p) Equilibrium distribution of individual utilities given no constitution & p
U(NC,n) Equilibrium distribution of individual utilities given no constitution & n
U(C1,p) Equilibrium distribution of individual utilities given constitution 1 & p
U(C1,n) Equilibrium distribution of individual utilities given constitution 1 & n

expected utility under every possible constitution is calculated and the constitutions are ranked by both labour types in the two regions. Using these rankings, regional majorities vote for their preferred option and a constitution is adopted if it receives the unanimous support of all regional majorities.

The chapter proceeds first with a characterization of the migration equilibrium in the absence of any constitution and under a representative constitutional arrangement presented in section V.2. In section V.3, some general results regarding the migration equilibrium under alternative constitutions are stated in several propositions. The constitution choice problem is formalized in section V.4. Chapter III and IV demonstrate that the migration equilibrium critically depends on the identity of the majority in each region. In addition, it is likely that the constitution adopted at the time of constitutional negotiations also affects the migration equilibrium. Thus, computed examples are provided for alternative population configurations in section V.5 Using numerical solutions, expected utilities can be calculated and the choice of constitution determined for each example. The results of a limited sensitivity analysis are presented in section V.6 while section V.7 concludes the chapter.

The Extended Model

The basic model developed in chapters III and IV requires some modification to investigate the concept of social insurance outlined above. To simplify the analysis, explicit functional forms for the production and utility functions are adopted.[58] Uncertainty takes the form of a production shock in region 1. Since regions are linked via the migration of type A individuals, this production uncertainty is transmitted to region 2. Using equation (III.31) and setting the technology parameter, S_i, to one in region 2 and θ_k in region 1, the production functions are:

$$y_1(\theta_k) = \theta_k\left[(T_1^A)^{(1-\alpha)}(L_1^A)^{\alpha} + (T_1 - T_1^A)^{(1-\beta)}(L_1^B)^{\beta}\right] \;,$$

$$\text{(V.1.1)} \qquad \textit{where } \theta_k = \theta_H > 1 \textit{ with probability } \pi$$

$$= \theta_L, \quad 0 < \theta_L < 1, \textit{ with probability } 1 - \pi \;,$$

$$\text{(V.1.2)} \qquad y_2 = \left[(T_2^A)^{(1-\alpha)}(L^A - L_1^A)^{\alpha} + (T_2 - T_2^A)^{(1-\beta)}(L_2^B)^{\beta}\right] \;,$$

for regions 1 and 2, respectively. The production functions in equations (V.1.1) and (V.1.2) maintain the assumptions of constant returns to scale and no interactive effects between labour types adopted in the basic model presented in the previous chapters.

Rents generated in each region on the fixed endowment of land are:

$$\text{(V.2)} \qquad R_1 = \theta_k\left[(1-\alpha)(T_1^A)^{(1-\alpha)}(L_1^A)^{\alpha} + (1-\beta)(T_1 - T_1^A)^{(1-\beta)}(L_1^B)^{\beta}\right] \;,$$

and

$$\text{(V.3)} \qquad R_2 = \left[(1-\alpha)(T_2^A)^{(1-\alpha)}(L^A - L_1^A)^{\alpha} + (1-\beta)(T_2 - T_2^A)^{(1-\beta)}(L_2^B)^{\beta}\right],$$

---

[58] These explicit functional forms are identical to those used in the numerical example presented in III.5 except for the addition of a production shock in region 1.

for regions 1 and 2 respectively. Income for a type h resident in region i consists of the individual's marginal product, F_i^h, and an equal share of rents, R_i and is written as:

$$z_i^h = F_i^h + \frac{R_i}{L_i^A + L_i^B} \quad , \tag{V.4}$$

where F_i^h equals $\partial y_i / \partial L_i^h$. Individual preferences, defined over the private good, x_i^h, and the public good, G_i, are represented by the utility function[59]:

$$U = (x_i^h)^\rho (G_i)^{1-\rho} \quad , \tag{V.5}$$

In the absence of any constitutional arrangements, private good consumption for a type h individual in region i can be written as:

$$x_i^h = z_i^h - \tau_i \quad , \tag{V.6}$$

where τ_i is a uniform head tax levied in region i.

In addition to choosing the level of the public good, G_i, the majority in region i can voluntarily transfer income to the residents of region j, given as TR_{ij}, and are constrained to finance these transfers with tax revenues raised by the uniform head tax. Thus, the budget constraint for the regional majority government in region i is:

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[59] The indirect utility function associated with equation (V.5) is linear in income but concave in the region's mobile population, or the unit price of the public good. As a result, individuals are risk averse.

$$G_i + TR_{ij} - TR_{ji} = \tau_i(L_i^A + L_i^B) \quad . \tag{V.7}$$

Since regional majorities are assumed to be non-myopic with respect to the effects of their choice of fiscal policy on their type A population, the majority in each region takes into consideration the equal utilities condition:

$$(x_1^A)^\rho (G_1)^{1-\rho} = (x_2^A)^\rho (G_2)^{1-\rho} \quad . \tag{V.8}$$

In addition, the model maintains the assumption that, when deciding its optimal fiscal policy, regional majorities take the other region's fiscal choices as given. Regional majorities also take as given any constitutionally-imposed taxes and transfers.

V.2 Migration Equilibrium Under Alternative Constitutions

As shown in figure V.1, individuals (and regional majorities) must first solve each possible migration equilibrium outcome in order to calculate their expected utility under each constitution as well as in the no constitution case. Thus, the analysis proceeds first with a characterization of these migration equilibria. Following this, the constitutional choice problem can be examined. For each constitution, the timing of actions is as follows: using the information available regional majorities choose to adopt a constitution or no constitution before the size of the production shock is known, and following this, the shock is revealed and regional majorities and the federal authority choose their fiscal variables simultaneously, taking as given any constraints imposed by the constitution. The results in chapter IV indicate that transfers made to regional majorities may not be accepted unless these transfers work to increase the utility of individuals in the majority. To avoid complications arising from the possible rejection of federal transfers, federal government transfers are assumed to be made directly to individuals rather than regional governments.

Each regional majority chooses the level of public goods provision and its voluntary transfer to maximize the utility of a representative individual from the majority coalition. Assuming type t individuals form the majority in region i, this problem can be formally written as:

$$\max_{G_i, TR_{ij}} \quad L = U(x_i^t, G_i) + \lambda\left(U(x_1^A, G_1) - U(x_2^A, G_2)\right) \; ,$$

subject to the equations of the model (equations (V.1.1), (V.1.2), (V.2) to (V.7)) and where $G_i \geq 0$, $TR_{ij} \geq 0$, $i = \{1,2\}$, $t \in \{A,B\}$, and $i \neq j$. Regional governments take as given federal taxes and transfers as specified by the existing constitutional agreement. The federal government's choices of taxes and transfers are determined in accordance with the principles specified in a constitution or are zero if no constitution is chosen. Below the feasible set of constitutions and what principles are specified in each are outlined.

Set of Constitutions

Production shocks in the model give rise to uncertainty with respect to income, rents, output, public goods and, therefore, utility. Constitutions can be viewed as providing varying degrees of public insurance. There exists an infinite number of feasible constitutions so it is necessary to somehow limit the number of constitutions considered. Here, five alternative constitutions are examined and cover a range of possible constitution types. Three constitutions based on equity or distributional concerns are proposed. The first two of these are based on an income sharing principle while a third constitution considers regional rent sharing. The remaining two constitutions focus on the allocation of mobile labour in the economy and the size of the economic pie rather than distributional issues.

Constitution 1 assigns a federal authority the necessary powers to equalize income for all individuals in the economy. Under constitution 2, a federal authority is responsible for ensuring all individuals of a given labour type have equal incomes. In keeping with the principle that both these constitutions create a second order of government, the federal authority is assumed to equalize gross income, or income before regional taxes and transfers. This assumption is adopted to reflect the idea that regional preferences may differ and that federal government policy allows regional authorities flexibility to pursue differing objectives. While constitution 1 provides insurance against variations in utility by labour type and by region of residence (but not by state of nature), constitution 2 insures individuals against variations in utility by labour type but not by region or state.

Income sharing within a constitution can be motivated by equity as well as insurance considerations. For example, in Canada, section 36(1) of the *Constitution Act 1982* commits the federal government of Canada to equality of opportunity and, as interpreted by Boadway and Hobson (1993), to the principle of equity. The complete income-sharing under constitution 1 implies an equalitarian view of equity. The income sharing by labour type implies a commitment to the principle of horizontal equity where like individuals (as defined by labour type) are treated alike.

Resource rents and revenues have long been the subject of much debate in Canada where these resources are provincially owned and where there is great regional disparity with respect to such rents. In particular, the treatment of resource revenues for the purposes of equalization in Canada has varied over the years and has been, at times, at the centre of this controversy. Given the significance of resource revenues in Canadian history, it is important to consider a constitution that incorporates some form of rent sharing. Constitution 3 assigns to the federal government the responsibility of ensuring that per capita rent shares are equalized across regions. This constitution can also be viewed as providing partial insurance for utility variations arising from regional variations in non-wage income.[60]

Constitution 4 assigns the federal authority the task of ensuring that the allocation of mobile labour maximizes the value of private output without taking into consideration the social marginal product of mobile labour. In contrast to the other constitutional arrangements considered, constitution 4 is based on allocative considerations rather than on insurance or equity principles. The final constitution, constitution 5 requires the federal government to ensure that the nation's mobile labour is optimally distributed as determined by the first order condition to the planner's problem, equation (III.24), derived in chapter III. Here, the federal authority ensures that the net social marginal benefit of population is equalized across regions.

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[60] Recall that in this model rents are assumed to be owned by residents or, equivalently, to be publicly owned and shared with residents on an equal per capita basis.

Under constitution 4, the federal government ensures that the contribution to output of an additional mobile worker is equated across regions while constitution 5 ensures that the marginal social product of mobile labour is equated across regions.[61] Constitutions 4 and 5 are included for purposes of comparison with the equalization called for in the traditional Boadway and Flatters (1982) sense, equalization to eliminate the inefficiencies associated with fiscally-induced migration. In contrast to the first three constitutions, the federal government must incorporate regional taxes and transfers when choosing its equalizing transfer in order to met the constitutionally specified goal under constitutions 4 and 5. This point is taken up in more detail below.

Finally, constitutions are assumed to take one of two forms. In the first instance, each constitution is assumed to include an enforceable clause that prohibits regional majority governments from making voluntary interregional transfers. In the second instance, the analysis examines each constitution with this clause omitted so that regional voluntary transfers are not constrained.

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[61] The marginal social product of mobile labour in a fiscal externality framework is discussed in chapter II and measures an individual's contribution to output minus the individual's private consumption.

Constitutional Arrangement 1: Complete Income Sharing

Under this arrangement the federal authority is assigned the necessary tax instruments, ϕ_1^A, ϕ_2^A, ϕ_1^B, and ϕ_2^B , to equalize individual gross incomes, or income before regional government taxes and transfers. Formally, the federal government chooses its taxes to satisfy the following conditions:

$$\text{(C1.1)} \qquad z_i^h + \phi_i^h = \frac{y_1 + y_2}{L^A + L_1^B + L_2^B} = y \quad \textit{for } h \in \{A,B\} \textit{ and } i \in \{1,2\} \quad ,$$

and

$$\text{(C1.2)} \qquad \sum_{i=1}^{2} \sum_{h=A}^{B} \phi_i^h L_i^h = 0 \quad \textit{(federal budget balance condition)} \quad .$$

The form of these conditions is not dependent on whether voluntary transfers are permitted since individual income *before* regional taxes and transfers is equalized. However, since a region's output and population size are dependent on whether or not transfers are made in equilibrium, the magnitudes of the federal taxes and transfers do depend on whether or not transfers are permitted.

Constitutional Arrangement 2: Income Sharing By Type

With this constitution the federal authority ensures that individuals of a given labour type have identical before-tax incomes. The federal authority chooses ϕ^A and ϕ^B to satisfy:

$$z_1^A + \frac{\phi^A}{L_1^A} = z_2^A - \frac{\phi^A}{L^A - L_1^A} \quad , \tag{C2.1}$$

and

$$z_1^B + \frac{\phi^B}{L_1^B} = z_2^B - \frac{\phi^B}{L_2^B} \quad . \tag{C2.2}$$

Note that the taxes are not region-specific as with constitution 1. This is consistent with the principle of horizontal equity where the federal authority treats like individuals alike. In this case likeness is defined as being of the same labour type. As in the case for constitution 1, the conditions governing the federal authority's behaviour are independent of whether or not the constitution includes a clause prohibiting voluntary transfers but the magnitudes of federal choice variables are not.

Constitutional Arrangement 3: Equal Per Capita Rent Shares

This constitutional arrangement assigns taxing powers to the federal authority to ensure that per capita rent shares are equal for all individuals regardless of an individual's region of residence. The federal authority chooses a lumpsum transfer,

ϕ^R, to satisfy:

$$\text{(C3.1)} \qquad \frac{R_1 + \phi^R}{L_1^A + L_1^B} = \frac{R_2 - \phi^R}{L^A - L_1^A + L_2^B} \quad .$$

Again, the equalizing rent transfer depends on whether voluntary transfers are permitted under the constitution only to the extent that the level of rents and population depends on whether these transfers occur in equilibrium.

Constitutional Arrangement 4: Maximize Output

Output for this economy is maximized when the marginal product of mobile, type A labour is equalized across regions. The federal authority must choose equalization, ϕ^y, such that:

$$F_1^A = F_2^A \quad .$$

Consider first the equalization payment required when voluntary transfers are not permitted. Using equations (V.4) and (V.7) and making the appropriate substitutions, the following expression for the marginal product of type A labour in regions 1 and 2 can be obtained:

$$\text{(C4.1)} \qquad F_1^A = x_1^A - \left(\frac{R_1 - G_1 - \phi^y}{L_1^A + L_1^B} \right) ,$$

and

$$F_2^A = x_2^A - \left(\frac{R_2 - G_2 + \phi^y}{L^A - L_1^A + L_2^B} \right) \qquad . \tag{C4.2}$$

Equating equations (C4.1) and (C4.2) and rearranging yields:

$$\phi^y = \left(\frac{(L_1^A + L_1^B)(L^A - L_1^A + L_2^B)}{L^A + L_1^B + L_2^B} \right) \left[\frac{R_1 - G_1}{L_1^A + L_1^B} - \frac{R_2 - G_2}{L^A - L_1^A + L_2^B} - \left(x_1^A - x_2^A \right) \right]. \tag{C4.3}$$

If voluntary transfers are permitted then the equalization transfer, ϕ_v^y, is chosen to satisfy:

$$\phi_v^y = \left(\frac{(L_1^A + L_1^B)(L^A - L_1^A + L_2^B)}{L^A + L_1^B + L_2^B} \right) \left[\frac{R_1 - G_1}{L_1^A + L_1^B} - \frac{R_2 - G_2}{L^A - L_1^A + L_2^B} - (x_1^A - x_2^A) \right]$$
$$- \left(TR_{12} - TR_{21} \right). \tag{C4.4}$$

Given a particular realization of the production shock, there is a unique distribution of mobile labour that ensures equality in the marginal product of type A labour. And since the federal transfer is chosen to ensure this condition is satisfied, the introduction of voluntary transfers in this case has no effect on the equilibrium. In other words, the magnitudes of ϕ^y and ϕ_v^y may differ but the net income transferred from one region to the other (federal plus regional transfers) is the same in either case. Thus, in the presence of this constitution, the equilibrium is identical whether or not voluntary transfers are permitted.

In contrast to constitutions 1 and 2, it is necessary for the federal authority to take into account regional taxes and transfers when choosing the appropriate equalization transfer to ensure that the marginal product of mobile labour is equalized in equilibrium. Differences in regional taxes, rent shares, and voluntary transfers, if permitted, creates incentives for type A individuals to move in response to these fiscal differences rather than to the region where their marginal product is highest. Thus, it is necessary for these differences to be incorporated in the federal authority's choice of transfer. The federal authority, however, takes regional variables, like taxes and transfers, as given when making its' choices. At the same time, regional majorities take as given the federal government's transfer when choosing their fiscal variables.

Constitutional Arrangement 5: Optimal Population Distribution

The final constitution assigns the federal authority the necessary powers to ensure an optimal distribution of mobile population is achieved in equilibrium, as defined by equation (III.24) derived in chapter III. Assuming voluntary transfers are not permitted, the federal government chooses ϕ^* to satisfy the following:

$$F_1^A - x_1^A = F_2^A - x_2^A \qquad ,$$

or, substituting out for x_i^A:

$$\frac{R_1 - G_1 - \phi^*}{L_1^A + L_1^B} = \frac{R_2 - G_2 + \phi^*}{L^A - L_1^A + L_2^B} .$$

Rearranging, the equalization required under constitution 5 without voluntary transfers is:

$$\text{(C5.1)} \qquad \phi^* = \left(\frac{\left(L_1^A + L_1^B\right)\left(L^A - L_1^A + L_2^B\right)}{L^A + L_1^B + L_2^B}\right)\left[\left(\frac{R_1 - G_1}{L_1^A + L_1^B}\right) - \left(\frac{R_2 - G_2}{L^A - L_1^A + L_2^B}\right)\right] .$$

If voluntary transfers are permitted, then ϕ_v^* is chosen to ensure the following condition is satisfied:

$$\frac{R_1 - G_1 - (TR_{12} - TR_{21}) - \phi_v^*}{L_1^A + L_1^B} = \frac{R_2 - G_2 + (TR_{12} - TR_{21}) + \phi_v^*}{L^A - L_1^A + L_2^B} .$$

Rearranging the above, the following expression for ϕ_v^* is found:

$$\text{(C5.2)} \quad \phi_v^* = \left(\frac{\left(L_1^A + L_1^B\right)\left(L^A - L_1^A + L_2^B\right)}{L^A + L_1^B + L_2^B}\right)\left[\left(\frac{R_1 - G_1}{L_1^A + L_1^B}\right) - \left(\frac{R_2 - G_2}{L^A - L_1^A + L_2^B}\right)\right] - (TR_{12} - TR_{21}) .$$

As is the case with constitution 4, since the optimum allocation is defined by a unique distribution of mobile labour, the federal authority must take into account regional taxes and transfers when choosing the equalization transfer. In contrast to the migration equilibrium under constitution 4, the migration equilibrium under constitution 5 is not generally characterized by equality of type A labour's marginal product across regions.

Table V.1 summarizes the set of constitutions available as well as the objectives and policy instruments specified in each. Note that, for the first three constitutions, the policy instruments are described by the same decision rule or equation. The magnitudes of the federal taxes and transfers depend, however, on whether voluntary transfers are permitted in equilibrium since the equilibrium levels of rents, wages, and mobile population are dependent on whether or not these transfers occur. For constitutions 4 and 5, both the form and the magnitude of federal transfers depend on whether voluntary transfers are permitted in equilibrium.

Table V.1: Summary of Constitutions and Federal Government Instruments

Constitution	**Objective**	**Instruments**	
		Voluntary Transfers Prohibited	**Voluntary Transfers Allowed**
1. **Complete Income Sharing**	equalize individual income before regional taxes and transfers	ϕ_1^A, ϕ_2^A, ϕ_1^B, and ϕ_2^B	ϕ_1^A, ϕ_2^A, ϕ_1^B, and ϕ_2^B
2. **Income Sharing By Type**	equalizes income or individuals of same labour type before regional taxes and transfers	ϕ^A and ϕ^B	ϕ^A and ϕ^B
3. **Rent Sharing**	equalizes per capita rent shares	ϕ^R	ϕ^R
4. **Maximize Output**	ensures marginal product of mobile labour is identical across regions	ϕ^Y	ϕ_V^Y
5. **Optimal Population Distribution**	ensures net marginal social benefit of mobile labour is identical across regions	ϕ^*	ϕ_V^*

V.2.1 Migration Equilibrium Without A Constitution (No Insurance)

If a consensus on one of the five constitutions is not achieved before the state of the world is revealed, then no constitution is adopted and there are no constitutional provisions for federally imposed taxes, transfers, or income sharing. The no constitution outcome is given by the standard migration equilibrium. Regional majorities choose their public goods and voluntary transfers as described in chapters III and IV after the production shock is revealed. Since individuals and regional majorities rank all constitutions relative to this outcome, it is necessary to first describe this equilibrium. In this case, the migration equilibrium is characterized by the following system of equations derived in chapter IV:

$$(x_1^A)^\rho (G_1)^{1-\rho} = (x_2^A)^\rho (G_2)^{1-\rho} \quad , \tag{V.9}$$

$${}_1U_G^I - \frac{{}_1U_x^I}{L_1^A + L_1^B} + {}_1U_x^I\left(\frac{\partial x_1^I}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial G_1}\right) \leq 0 \ , \ G_1 \geq 0 \ \textit{and} \ G_1\frac{\partial U}{\partial G_1} = 0, \tag{V.10}$$

$$\frac{-{}_1U_x^I}{L_1^A + L_1^B} + {}_1U_x^I\left(\frac{\partial x_1^I}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial TR_{12}}\right) \leq 0, \ TR_{12} \geq 0 \ \textit{and} \ TR_{12}\frac{\partial U}{\partial TR_{12}} = 0, \tag{V.11}$$

$${}_2U_G^m - \frac{{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m\left(\frac{\partial x_2^m}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial G_2}\right) \leq 0, \ G_2 \geq 0 \ \textit{and} \ G_2\frac{\partial U}{\partial G_2} = 0, \tag{V.12}$$

(V.13) $$\frac{-{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m\left(\frac{\partial x_2^m}{\partial L_1^A}\right)\left(\frac{\partial L_1^A}{\partial TR_{21}}\right) \leq 0, TR_{21} \geq 0 \textit{ and } TR_{21}\frac{\partial U}{\partial TR_{21}} = 0,$$

where t and m respectively represent the identity of the majority in regions 1 and 2. The perceived migration response functions are:

(V.14) $$\frac{\partial L_1^A}{\partial G_1} = \frac{-\left({}_1U_G^A - \dfrac{{}_1U_x^A}{L_1^A + \overline{L_1^B}}\right)}{{}_1U_x^A\dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\dfrac{\partial x_2^A}{\partial L_1^A}},$$

(V.15) $$\frac{\partial L_1^A}{\partial G_2} = \frac{\left({}_2U_G^A - \dfrac{{}_2U_x^A}{L^A - L_1^A + \overline{L_2^B}}\right)}{{}_1U_x^A\dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\dfrac{\partial x_2^A}{\partial L_1^A}},$$

(V.16) $$\frac{\partial L_1^A}{\partial TR_{12}} = \frac{\left(\dfrac{{}_1U_x^A}{L_1^A + L_1^B} + \dfrac{{}_2U_x^A}{L^A - L_1^A + L_2^B}\right)}{{}_1U_x^A\dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\dfrac{\partial x_2^A}{\partial L_1^A}},$$

(V.17) $$\frac{\partial L_1^A}{\partial TR_{21}} = \frac{-\left(\dfrac{{}_1U_x^A}{L_1^A + L_1^B} + \dfrac{{}_2U_x^A}{L^A - L_1^A + L_2^B}\right)}{{}_1U_x^A\dfrac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A\dfrac{\partial x_2^A}{\partial L_1^A}}.$$

Equations (V.10) to (V.13) represent the Kuhn Tucker conditions for regional choices of G_1, TR_{12}, G_2, and TR_{21} respectively while equation (V.9) is the equal utilities condition that must hold in equilibrium. Note that the size of the production shock affects the marginal product of both labour types in region 1 and, since regions are linked by the migration of type A labour, the marginal products of both labour types in region 2 are affected. As a result, all the above derivatives are dependent on the size of the production shock as is the equilibrium outcome.

V.2.2 Migration Equilibrium With A Constitution (With Insurance)

(i) No Voluntary Transfers Permitted

The migration equilibrium in this case is characterized by the two first order conditions describing regional choices of the public good, the equal utilities condition, and the constitutional conditions given by the constitution chosen before the size of the production shock is known. Thus, the migration equilibrium is characterized by equations (V.9), (V.10), (V.12), (V.14), (V.15) plus the relevant constitutional conditions.

(ii) Voluntary Transfers Permitted

The migration equilibrium given a particular constitution, C, is characterized by equations (V.9) to (IV.17), plus the relevant constitutional conditions governing the federal government's choices. For example, if constitution 1 is adopted, the migration equilibrium is characterized by equations (V.9) to (V.17) and (C1.1) and

(C1.2). In this particular example, there are nine endogenous variables, G_1, G_2, TR_{12}, TR_{21}, L^A_1, ϕ^A_1, ϕ^A_2, ϕ^B_1, and ϕ^B_2 and nine equations. These nine equations include (C1.2) and the three linearly independent conditions in (C1.1), the four conditions determining regional levels of the public good and transfers, and the equal utilities condition.

V.3 Characterization of Equilibria Under Alternative Constitutions

The above descriptions of the potential migration equilibria are very general. Despite the multiplicity of effects that characterize the model, some general propositions regarding equilibrium outcomes under alternative constitutions can, however, be stated. These propositions clearly demonstrate that the characterization of the migration equilibrium under some constitutions is critically dependent on the existing population configuration, or the identities of regional majorities. Some constitutions are, for example, shown to eliminate all regional differences while regional differences can persist under other constitutional arrangements. In addition, these propositions are useful in the numerical analysis presented later in this chapter.

Proposition 9.

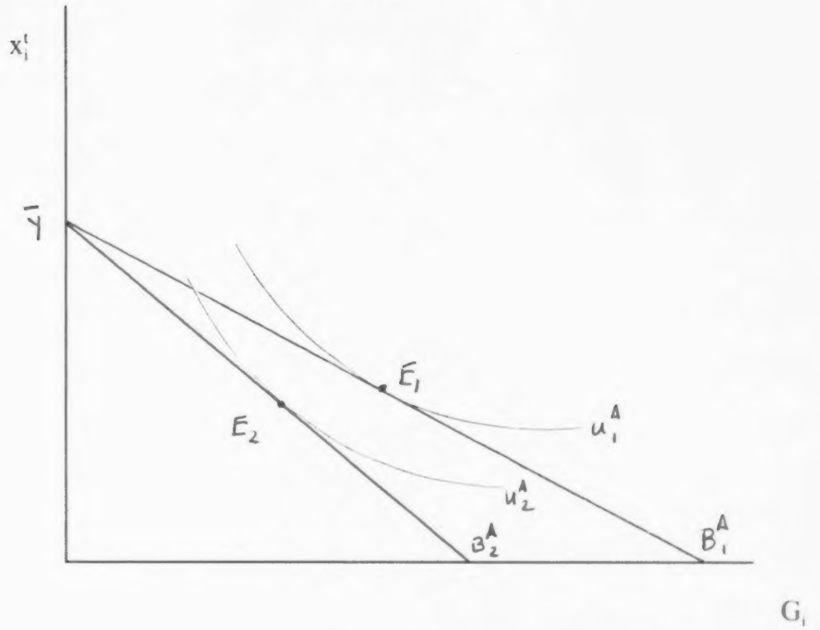
If no voluntary transfers are permitted , then the migration equilibrium under constitution 1 is characterized by regions of equal size and identical levels of regional public good provision. This result is independent of the identity of either regional majority.

To see this, consider the budget constraint for each regional majority in (G_i,

x_1^b) space as illustrated in figure V.2. Since under constitution 1 all individuals have identical incomes before regional taxes, the budget constraint facing each regional majority is anchored at the same point, $\bar{y}$, on the vertical axis. To satisfy the equal utility constraint for type A individuals, the fiscal package in each region must be such that all type A individuals have a consumption bundle that leaves them on the same indifference curve. Suppose type A forms the majority in both regions. In equilibrium can regions be of different sizes or, in other words, is the allocation of type A labour given by L_1^{A*} such that $(L_1^{A*}+L_1^B) \neq (L^A-L_1^{A*}+L_2^B)$ possible in equilibrium?

Suppose that $(L_1^A+L_1^B) > (L^A-L_1^A+L_2^B)$ and that the type A majority in regions 1 and 2 face budget constraints B_1^A and B_2^A respectively. Given these budget constraints regional majorities choose the fiscal package in the region so as to maximize the utility of a representative type A resident, denoted as E_1 and E_2 in figure V.2. Given E_1 and E_2, type A individuals in regions 1 and 2 have utility equal to U_1^A and U_2^A respectively. Since $U_1^A > U_2^A$, the equal utilities condition for type A individuals is violated. Thus, E_1, E_2, and L_1^{A*} do not represent a migration equilibrium under constitution 1. In equilibrium it must be the case that both regional budget constraints are tangent to the same indifference curve for type A individuals. As both budget constraints are anchored at $\bar{y}$, the equal utilities condition

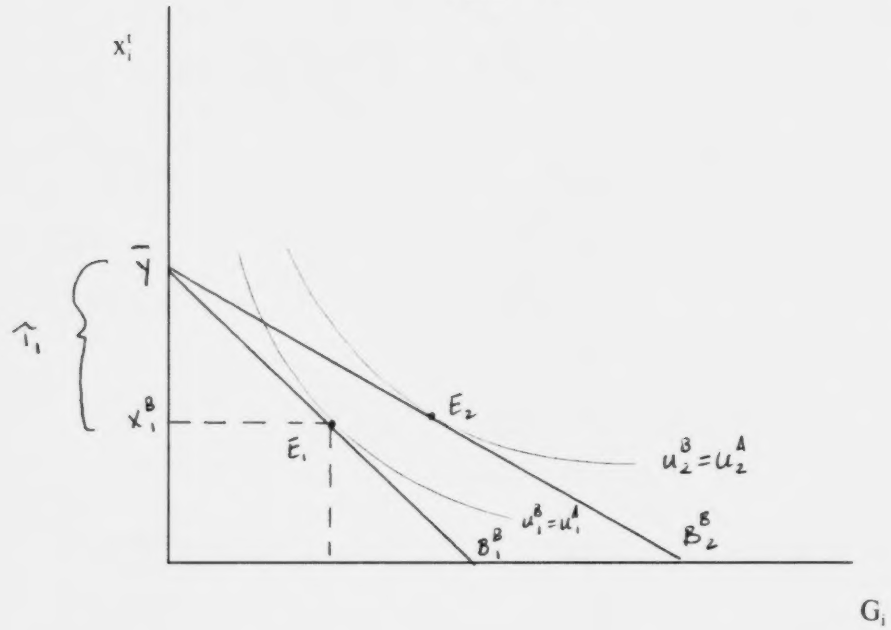
Figure V.2



requires that regional budget constraints coincide. Hence, the price of a unit of the public good and the choice of fiscal package are identical in both regions. This is the only possible migration equilibrium when the complete income sharing constitution is in place, no voluntary transfers are made, and type A labour forms the majority in both regions. Under these circumstances all individuals consume the same consumption bundle and have the same level of utility. Constitution 1 provides insurance against variations in utility by both labour type and region of residence once the production shock is known. Note that the constitution does not offer insurance against variations in utility arising from different realizations of the production shock.

Alternatively, suppose type B individuals form the majority in both regions and regional populations are of unequal size. For example, assume region 1 is smaller than region 2 such that $(L_1^A+L_1^B) < (L^A-L_1^A+L_2^B)$. Regional government budget constraints, B_1^B and B_2^B, for regions 1 and 2 respectively are illustrated in figure V.3 below. Each type B majority chooses the fiscal package to maximize the utility of a representative type B resident. If voluntary transfers are prohibited or if both regional majorities choose a zero transfer, then at their optimal choices, each regional budget constraint is just tangent to a type B resident's indifference curve as illustrated by E_1 and E_2. Can E_1 and E_2, where G_1 does not equal G_2, be a migration equilibrium under constitution 1? The answer is no.

Figure V.3



Under constitution 1, all individuals have pre-tax income equal to $\bar{y}$. The consumption package (G_1, x_1^B) for type B individuals is identical to the consumption package (G_1, x_1^A) for type A residents in the region since public goods are financed by a uniform head tax. So if all individuals in region 1 start with $\bar{y}$, then $(\bar{y} - \tau_1)$ is also the same for all individuals in region 1. Therefore, residents in region 1 have the same level of utility regardless of their labour type. Applying similar reasoning for region 2, all residents in region 2 must have identical utility under this constitution. Since the price of the public good differs across regions, $U_2^A > U_1^A$ and clearly the equal utilities condition for type A individuals is not satisfied. The only way for the equal utilities condition to be satisfied is for the fiscal package to be the same in both regions. Therefore the migration equilibrium under constitution 1 is characterized by regions of equal size, identical fiscal packages, and the same level of utility for individuals regardless of their region of residence or labour type. Similar reasoning leads to the same conclusion about the migration equilibrium under constitution 1 when the identity of the majority differs across regions.

Proposition 9 shows that a complete income sharing constitution prohibiting voluntary regional transfers eliminates all regional differences. In other words, to achieve the equity objective under constitution 1 while at the same time allowing some regional diversity, voluntary interregional transfers must be permitted under the constitution. Once voluntary interregional transfers are permitted, regional budget constraints can be discontinuous at $\bar{y}$. In this case, it is possible for fiscal packages and the price of the public good to be regionally differentiated and still ensure that type A individuals have equal utility in both regions. Thus, a complete income sharing constitution that permits voluntary transfers allows regions some scope to differentiate themselves. This option appears to be more consistent with a federal system that is comprised of two orders of government each with its own sphere of influence.

Proposition 10.

Constitution 1, the complete income sharing constitution, fully insures individuals against variations in utility by labour type and by region once the production shock is realized. This result is independent of whether or not voluntary transfers are permitted and the identities of regional majorities.

Proposition 9 demonstrates that regions have the same fiscal package, face the same price for the public good and are the same size under constitution 1 when voluntary transfers are not permitted in equilibrium. This implies that individuals have identical utility in the migration equilibrium under the complete income sharing constitution with no transfers. Proposition 10 summarizes the extent of insurance provided under constitution 1 for the more general case where transfers are permitted but need not necessarily occur in equilibrium.

Proposition 9 proves the result that constitution 1 eliminates variations in utility by labour type and by region when voluntary transfers are not permitted, therefore proving part of proposition 10. That variations in utility by labour type and by region are also eliminated under constitution 1 when transfers are permitted and occur in the migration equilibrium, is a direct result of the assumptions that public goods and voluntary transfers are financed by uniform head taxes and that voluntary transfers are distributed uniformly among residents of a region. Recall that under the complete income sharing constitution all individuals have identical pre-tax income, y. Regardless of the choice of fiscal package in each region, uniform head taxation (or uniform subsidy as is the case with voluntary transfers) ensures that all individuals within a region have identical consumption bundles and, hence, utility. In other words, $U(x_1^A, G_1) = U(x_1^B, G_1)$ and $U(x_2^A, G_2) = U(x_2^B, G_2)$. In addition, the equal utilities condition ensures that $U(x_1^A, G_1) = U(x_2^A, G_2)$ in equilibrium. Therefore, $U(x_1^B, G_1)=U(x_2^B, G_2)$ and all individuals must have identical utility in equilibrium. Since these equalities hold in any migration equilibrium given constitution 1 and do not depend on the identity of regional majorities, proposition 10 is proved.

Proposition 11.

The migration equilibrium under constitution 2 is characterized by regions of equal size and identical levels of public goods provision across regions if voluntary transfers are not permitted and if type A individuals form the majority in both regions.

Recall that constitution 2 ensures that individuals of the same labour type have identical incomes before regional taxes and transfers. If type A individuals form the majority in both regions then the budget constraints for regional majorities are again anchored at the same position. Without transfers, regional budget constraints must coincide in order to satisfy the equal utilities condition. Each region must face the same unit price for the public good which implies that regions are of equal size and the same level of public good is provided in both regions in equilibrium. This result breaks down, however, if either voluntary transfers are permitted and occur in equilibrium or if the immobile labour type forms the majority in at least one region.

Consider the case where voluntary transfers are made and the mobile labour type continues to form the majority in both regions. As noted in the discussion of proposition 9, with voluntary transfers, regional majority budget constraints are discontinuous at y^A, the before-tax income for type A individuals regardless of region of residence. In this case, type A residents of region 1 need not have the same after-tax incomes as the type A residents of region 2, as is required in the case where transfers are prohibited. Therefore, it is again possible for regional fiscal packages to differ while at the same time ensuring that the equal utilities condition for type A individuals is satisfied in equilibrium.

If the immobile labour type forms the majority in at least one region, then proposition 10 no longer holds. Consider the case where a type B majority exists in region 1 and a type A majority in region 2. Under constitution 2, type B individuals have the same before-tax income regardless of region. Applying similar reasoning as above shows that, with or without transfers, it is possible for regional fiscal packages to differ while at the same time satisfying the equal utilities condition for mobile individuals.

Proposition 12.

If the immobile type forms the majority in at least one region and if no transfers occur or are permitted in equilibrium, a necessary condition characterizing the migration equilibrium given constitution 2 is that if $G_1 \overset{<}{\underset{>}{-}} G_2$ *then* $x_1^A \overset{>}{\underset{<}{-}} x_2^A$ *. Under this constitution regions may differ with respect to population size.*

To see this consider figure V.4. Consider the case where type B individuals form the majority in both regions. Under constitution 2, all type B individuals have identical pre-tax income equal to y^B and all type A individuals have pre-tax income equal to y^A. There is no requirement in this case, however, that y^A equal y^B. To illustrate, suppose y^A is less than y^B in equilibrium. Can the migration equilibrium be characterized by regions with different fiscal packages? In this case, the answer is yes.

Assume that region 1's population is smaller than region 2's. As a result, B_1^B and B_2^B represent the budget constraints faced by the type B majority in regions 1 and 2 respectively. With no voluntary transfers, the optimal choice of fiscal package is given as E_1^B for region 1 and E_2^B for region 2. Unlike the equilibrium under constitution 1, while all residents in a given region face the same head tax, all residents do not have identical consumption bundles. For example, in region 1, type B individuals consume the package described by E_1^B; type A individuals in the region consume a bundle somewhere along the locus G_1G_1 below E_1^B, such as E_1^A.[62] All that is required in the migration equilibrium to satisfy the equal utilities condition for type A individuals, is, given E_2^B, the bundle for type A individuals in region 2, E_2^A, lie on

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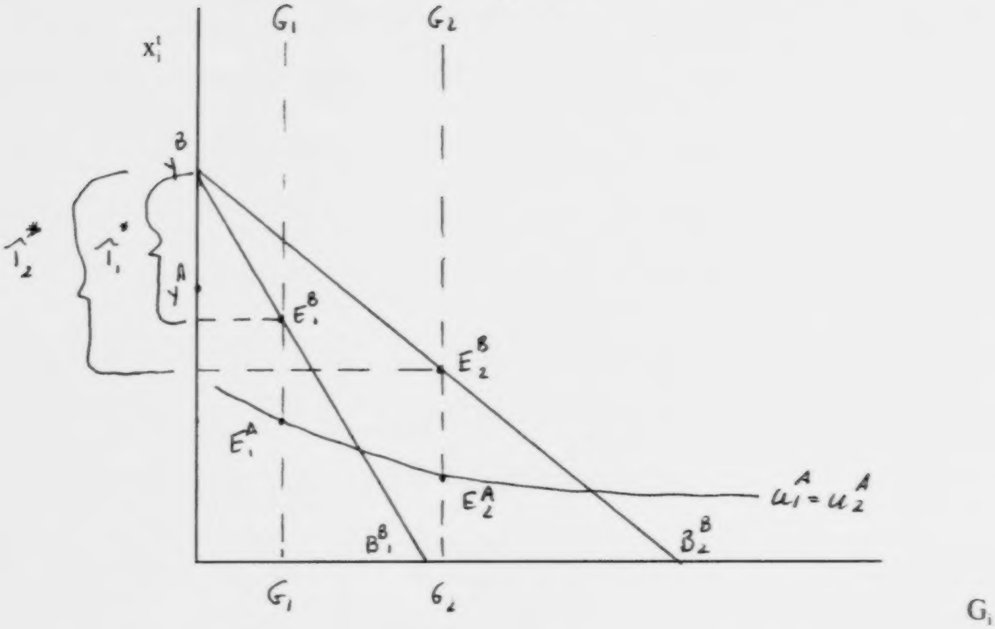
[62] If an imaginary budget constraint for type A individuals in region i is drawn in figure V.4, this budget constraint would be parallel to the budget constraint for type B individuals in the region and E_i^A would lie on this budget constraint.

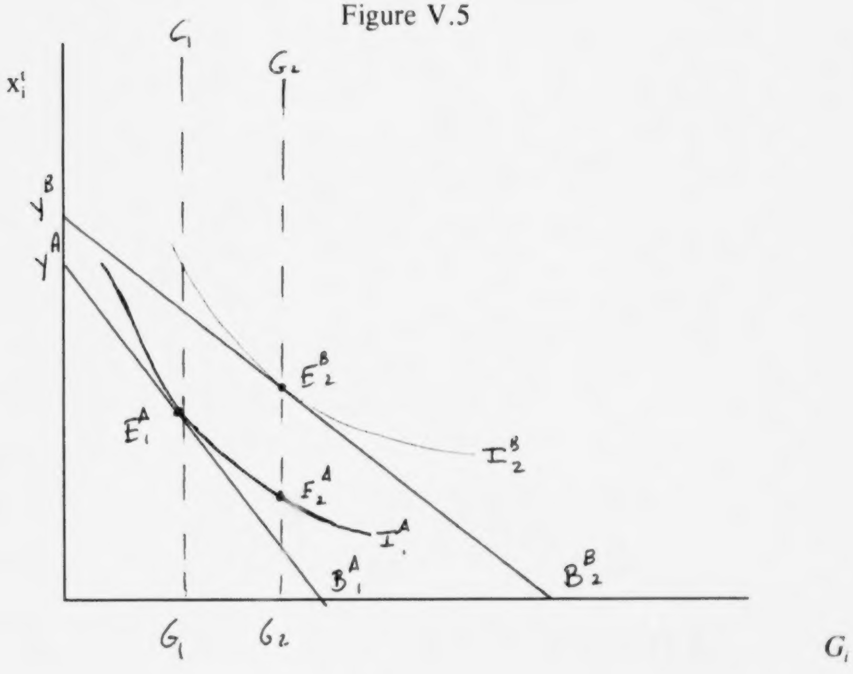
Figure V.4



the same indifference curve as E_1^A and along the G_2G_2 locus. So it is not necessary that regions be of equal size in the migration equilibrium given constitution 2 and no voluntary transfers when immobile individuals form the majority in both regions. In order for E_1^A and E_2^A to lie on the indifference curve given by $U_1^A = U_2^A$, it must be the case that the migration equilibrium is characterized by the following condition: if $G_1 \overset{<}{\underset{>}{-}} G_2$ then $x_1^A \overset{>}{\underset{<}{-}} x_2^A$.

When the identity of regional majorities differ and no voluntary transfers are made, the migration equilibrium is not necessarily characterized by regions of equal size with identical fiscal packages. Figure V.5 illustrates one possible migration equilibrium. Region 1 has a type A majority while a type B majority exists in region 2. Given the budget constraint, B_1^A, the majority in region 1 chooses G_1. In region 2, the immobile majority chooses G_2 given B_2^B and consumes at point E_2^B. Since y^A is less than y^B, and G_2 is financed by a uniform head tax, x_2^A must be lower than x_2^B and type A residents must consume somewhere along the G_2G_2 locus below E_2^B. To satisfy the equal utilities condition, the consumption bundle for type A individuals in region 2, E_2^A, must lie on I_1^A. Thus, if regional populations differ in size, the migration equilibrium is characterized by the following condition: if $G_1 \frac{<}{>} G_2$, then $x_1^A \frac{>}{<} x_2^A$.

Figure V.5



Summary

Propositions 9 to 12 demonstrate that particular constitutions can eliminate all interregional differences in populations and fiscal packages given certain population configurations and the absence of voluntary transfers and, in some cases, constitutions can eliminate all differences in utility levels by region and by labour type. In addition, chapter IV shows that whether or not transfers are made in a migration equilibrium also depends on the population configuration in the economy and the identity of the labour type that forms the majority in each region. In the following section, the constitution choice problem is examined under alternative assumptions regarding the availability of information at the time of constitutional negotiations.

V.4 Constitutional Choice Under Uncertainty

Individuals, having characterized each possible migration equilibrium and having determined the utility level attached to each equilibrium possibility, calculate their expected utility under each constitution.[63] Individuals know the structure of the model and the probability attached to each possible production shock. Moreover, individuals know the relative sizes of regional type A and B populations in all potential equilibria and, as a result, know the identity of regional majorities. These expected utility calculations are dependent on the information set, $\Omega \in \{\Omega_a, \Omega_b, \Omega_c\}$ (to be defined below), regarding individual characteristics and the production shock available at the time of constitutional negotiations.

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[63] Since regional majorities are, in fact, the participants to the constitutional negotiations, regional majorities also perform these expected utility calculations for a representative individual of the majority type.

(a) Production Uncertainty Only: $\Omega=\Omega_a$

In this case, individuals possess full information regarding their labour type and region of residence in equilibrium but are uncertain as to the magnitude of the production shock. As a result, each individual calculates expected utility as follows:

$$EU_i^h(C_n) = \pi U(x_i^h,\ G_i;\theta_H,\ C_n) + (1-\pi)U(x_i^h,\ G_i;\theta_L,C_n)\ ,$$

for C_n={no constitution, C1, C2, C3, C4, C5} and i={1,2} and h={A,B}. Individuals use these calculations to rank constitutions in expected utility terms relative to the migration equilibrium without any constitution.

(b) Production and Region of Residence Uncertainty: $\Omega=\Omega_b$

Individuals possess full information regarding their labour type and their mobility but do not know with certainty the region in which they will reside in equilibrium or the size of the production shock. For mobile individuals, uncertainty regarding region of residence does not affect their expected utility calculations since utility for these individuals is identical across regions. In this case, the expected utility for type A individuals is:

$$EU^A(C_n) = \pi U(x_i^A,\ G_i;\theta_H,\ C_n) + (1-\pi)U(x_i^A,\ G_i;\theta_L,C_n)\ .$$

Since utility is identical for all type A individuals regardless of their region of residence, the expected utility for type A individuals is calculated using the utility levels for a type A individual in region i only.

Immobile individuals know only the probability of residing in a particular region at the time of constitutional negotiations. This has the effect of making all type B individuals identical at this point in time. For type B individuals, expected utility is:

$$EU^{B}(C_n) = \pi\left(\frac{L_1^{B}}{L_1^{B}+L_2^{B}}U\left(x_1^{B},\ G_1;\theta_H,\ C_n\right)+\frac{L_2^{B}}{L_1^{B}+L_2^{B}}U\left(x_2^{B},G_2;\theta_H,\ C_n\right)\right)$$

$$+(1-\pi)\left(\frac{L_1^{B}}{L_1^{B}+L_2^{B}}U\left(x_1^{B},\ G_1;\theta_L,C_n\right)+\frac{L_2^{B}}{L_1^{B}+L_2^{B}}U\left(x_2^{B},G_2;\theta_L,C_n\right)\right) .$$

Note that for type B individuals the probability of residing in region i is equal to region i's share of the total type B population, $L_i^B/(L_1^B+L_2^B)$.

(c) Production, Labour Type and Region of Residence Uncertainty: $\Omega=\Omega_c$

If individuals are uncertain as to their labour type, their region of residence, and the size of the production shock, then at the time of constitutional negotiations, all individuals are effectively identical. In this case, each individual now has expected utility:

$$EU(C_n) = \left(\frac{L^{A}}{L^{A}+L_1^{B}+L_2^{B}}\right)EU^{A}(C_n) + \left(\frac{L_1^{B}+L_2^{B}}{L^{A}+L_1^{B}+L_2^{B}}\right)EU^{B}(C_n) \quad ,$$

where the set of possible constitutions is the same as above and the probability of being a type A and B individual equals the share of that labour type in the total population. These calculations allow individuals and regional majorities to rank the available alternatives and determine the constitutions that yield preferred outcomes relative to the outcome where no constitution exists. When no constitution is chosen, there is no federal government and regional majorities choose the level of public goods provision and voluntary transfers as described in sections IV.2 and IV.3 of chapter IV.

Constitution Choice: Voting Rule

Whether or not a particular constitution is chosen before the state of the world is known depends on who participates or votes in the constitutional negotiations and the decision rule for adopting a constitution. Here, regional majorities are assumed to be the participants to the constitutional negotiations and a unanimity rule is adopted as the collective decision rule governing these negotiations.[64] The model's complexity plus the dependence of fiscal decision rules on the identities of regional majorities make it impossible to derive unambiguous predictions regarding the constitutional outcome and the resulting migration equilibrium. In the next section, several numerical examples are considered which illustrate the model's characteristics. Using these examples, the influence of the availability of information and the identity of each regional majority on the choice of constitution can be examined.

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[64] An interesting variant for future consideration is a majority rule for constitutional choice where regions vote with or without the additional constraint that there is majority consent within a region. For this to be an interesting case to consider, however, there must be more than two regions.

V.5 Constitution Choice: Computed Examples

The initial parameter values are chosen such that regions have identical endowments of land, and the exogenous amounts of land allocated to each labour type for production are identical in both regions as are the production coefficients. For the cases in which the identity of the majority in each region is the same, the immobile population is assumed to be of equal size in both regions. The overall effect of these assumptions is to minimize the exogenous differences between regions. From the point of view of production, the only differences between regions is the production shock occurring in region 1 and the regional availability of mobile labour which is endogenously determined. The analysis, therefore, focuses on regional differences created by the production shock in region 1. The identity of each regional majority is, however, an additional factor that can give rise to regional differences in the composition of individual consumption bundles.

Given the initial set of parameter values, shown in table V.2a, the potential migration equilibria under alternative constitutions are computed for three population configurations. The first is that in which the mobile individuals form the majority in both regions. In the second, the immobile type is assumed to form the majority in both regions, and, in the third example, the identity of the regional majority is assumed to differ across regions. Each example requires different parameter values for L^A, L_1^B and L_2^B which are given below in table V.2b.[65] The computed migration equilibria are calculated for each population configuration and for each possible constitution (both with and without voluntary transfers) and for the case where no constitution is chosen. These numerical results are presented in tables C1 to C8 in appendix C.

Table V.2a: Production and Utility Parameter Values

	Parameter Values
T_1	4000
$T_1^A=(T_1-T_1^A)=T_1^B$	2000
T_2	4000
$T_2^A=(T_2-T_2^A)=T_2^B$	2000
α	0.5
β	0.5
ρ	0.75
θ_H	1.01
θ_L	0.97
S_1	1.00

Table V.2b: Population Parameter Values

	L^A	L_1^B	L_2^B
Type A Majority in Both Regions	5000	2000	2000
Type B Majority in Both Regions	5000	3500	3500
Identity of Regional Majorities Differ	5000	1000	4000

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[65] For the numerical simulations, regional population parameters are chosen such that majorities with the desired identities emerge under all possible constitutions and realizations of the production shock.

Using the numerically computed equilibrium utility levels for each possible realization of the production shock under all constitutional scenarios, the expected utility for each type of individual in both regions can be determined for all potential equilibria. With this information, the alternative constitutions can be ranked by type A and B individuals in each region. As noted in section V.3, since the probability attached to different utility levels affects the expected utility calculations, individual rankings depend on the information that is available at the time of constitutional choice. In particular, individual rankings of constitutions are determined for each population configuration when production uncertainty alone exists, when both production and region of residence are not known with certainty, and finally when individuals are uncertain as to the production shock, their region of residence and their labour type and individuals are, therefore, ex-ante identical.

Using the data available in tables C1 to C8, it can be shown that the choice of constitution for each population configuration considered is unaffected by whether voluntary transfers are permitted under a constitution. For the particular parameter values selected, voluntary transfers, when permitted, are chosen for the population configuration where the mobile type forms the majority in both regions. In this case, individuals' expected utility depends on whether or not voluntary transfers are made in equilibrium as do individuals' ordinal ranking of constitutions. The constitution that receives the unanimous support of both regional majorities, however, is the same whether or not transfers are made.

When the immobile type forms the majority in at least one region, majorities prefer larger mobile populations relative to smaller populations given the parameter values in tables V.2a and V.2b. Since a positive voluntary transfer works to reduce the size of the region's mobile population, in this case, regional majorities choose to make zero voluntary transfers when transfers are permitted by the constitution. As a result, the equilibrium with voluntary transfers permitted is identical to the migration equilibrium where voluntary transfers are not permitted. Therefore, the results for when voluntary transfers are permitted can be jointly summarized in table V.3 with the results for the case where such transfers are prohibited by the constitution.[66]

Table V.3 shows the constitutional outcome for each of the three alternative population configurations considered and how these constitutional choices are influenced by the availability of information. For example, when population

Table V.3:
Summary of Constitutional Choices by
Population Configuration and Available Information
Voluntary Transfers Permitted / Not Permitted Under the Constitution

	Information Set		
	(a) Production Uncertainty Only	**(b) Production and Region of Residence Unknown**	**(c) Production, Region of Residence and Type Unknown**
Type A Majority in Both Regions	C1	C1	C1
Type B Majority in Both Regions	C1	C1	C1
Type A Majority in Region 1 & Type B Majority in Region 2	NC	NC	C3

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[66] Since regional majorities are the participants to the constitutional negotiations, rankings of constitutions by regional majorities are identical to the rankings for the individual type that forms the majority in the region. These individual rankings are shown in tables V.4 to V.7.

parameters are chosen such that the mobile type forms the majority in both regions, regional majorities unanimously adopt constitution 1 when individuals are uncertain only about the size of the production shock. This choice is unaffected by the availability of information in that constitution 1 continues to be adopted if individuals are uncertain as to their region of residence or their labour type or both in addition to the production uncertainty. Similar results are found for the case where the immobile type forms the majority in both regions. In this case, constitution 1 also receives unanimous regional majority support and this constitutional choice is unaffected by the information available at the time of constitutional negotiations. In contrast, when a type A majority exists in region 1 and a type B majority exists in region 2, no constitution receives unanimous consent when individuals face production uncertainty alone or when individuals are uncertain as to the size of the production shock and their region of residence. When individuals are ex-ante identical and therefore uncertain as to their region of residence, their labour type and the production shock, then constitution 3, the rent sharing constitution, is the only constitution that is unanimously preferred to the no constitution option. Thus, the choice of constitution appears to be somewhat sensitive to the identity of regional majorities. The availability of information affects constitutional choice only in the case where the identity of regional majorities differ.

Discussion

The results in table V.3 indicate that consensus on one of the five constitutions considered between regional majorities is more likely if the "preferences" of regional majorities are the same in both regions. For the case where the identity of regional majorities differs, consensus is less likely and, where a constitution is adopted, the choice of constitution differs from the type of constitution that is adopted when regional majorities are of the same type. The amount of information available at the time of constitutional negotiations influences the likelihood of reaching a consensus only for the mixed majority population configuration.[67] Where the regional majorities are of the same type, constitution 1, the complete income sharing constitution, is the constitution most likely to be adopted. As demonstrated in proposition 10, this constitution provides insurance against variations in utility once the size of the production shock is known (full ex-post insurance). In contrast, the rent sharing constitution is the only option to receive unanimous support when the identity of the majority differs across regions. This constitution provides partial insurance and less insurance than constitution 1 since, in equilibrium, utility may vary by both labour type and region of residence, as is shown in table C7 and C8 in appendix C.

It is interesting to note that neither the efficiency constitution or the optimal constitution is adopted. Even when individuals are ex-ante identical at the time of constitutional decision-making, these constitutions fail to achieve the unanimous support of both regional majorities. As is shown in tables V.4 to V.7, the optimal constitution is ranked highest by type A individuals only when mobile individuals are in the minority in both regions. In contrast, type B individuals prefer this constitution to the no constitution case most often when these individuals are in the minority. This is not unexpected since the optimal constitution works to incorporate the net social benefits of an optimally distributed population and, therefore, works to improve the lot of regional minorities (since their utility is not incorporated into majority decision-making). Since this constitution implies some redistribution away from individuals in the majority to individuals in the minority, this constitution is unlikely to be a preferred option for regional majorities.

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[67] Results for the choice of constitution when individuals are the participants each with a veto power can be directly determined from tables V.4 to V.7 depicting individual rankings. As expected, consensus is more difficult to obtain and is usually achieved only in the case where individuals have no information regarding their labour type and are ex-ante identical. In general, constitution 1 is adopted when the majority in both regions are of the same labour type while in the mixed majority case the rent sharing constitution is chosen. The identity of each regional majority continues to be an important determinant of constitutional choice since different regional majorities imply differences in population configurations as well as different decision rules governing regional fiscal choices in the migration equilibrium.

One might expect that if all individuals are ex-ante identical then there exists an incentive to adopt the efficiency constitution to ensure the total output available to be distributed is as large as possible. Since this constitution is not adopted in any example considered and since it is often ranked lower than the no constitution outcome, the benefits of ensuring a larger pie must be outweighed by the costs associated with the relatively large uninsured variation in utility that occurs under this constitution. Instead, the adoption of constitution 1 over the efficiency constitution when all individuals are ex-ante identical, regional majorities are of the same type and regions are relatively symmetric, implies that risk aversion on the part of individual and regional majorities creates incentives for adopting a constitution that provides some ex-post insurance to against variations in utility.

In contrast, for the mixed majority case when all individuals are ex-ante identical, the cost of a constitution that provides full ex-post insurance against variations in utility by labour type and by region of residence are sufficiently large that a constitution that offers less insurance is preferred. One possible explanation is that, unlike the case where regional majorities are of the same labour type, the composition of regional population is more dissimilar under the alternative constitutions in the mixed majority case and this dissimilarity increases the costs of adopting constitution 1. For example, constitution 1 requires that regional populations be equal in size in equilibrium as is demonstrated in proposition 9. In the mixed majority case considered here, region 2 has a relative large immobile population while region 1 has a small immobile population. For regions to have equal population sizes, this necessarily implies a larger type A population in region 2 than in region 1. Given this characteristic, the divergence in the marginal product of type A labour across regions is relatively large as is the extent of the allocative inefficiency under constitution 1. It might be this characteristic that makes the complete income sharing constitution unappealing in the mixed majority case. In contrast, the rent sharing constitution results in similar population proportions across regions, less divergence in the marginal product of mobile labour, and higher total output which seems to be preferred to other alternatives, at least when all individuals are ex-ante identical. Large differences in the total population size of regions in the absence of a constitution suggests that variations in per capita rents shares are potentially large. It appears then that regional majorities prefer to obtain insurance against variations in non-wage income when the identity of the majority differs across regions. In other words, the cost of insurance against variations in total income implied under constitution 1 is too great.

Individuals' Rankings

Individual rankings of constitutions used to determine the constitutional outcomes shown in table V.3 are presented in tables V.4 to V.7. Individuals' and, therefore, regional majorities' rankings of constitutions appear to be sensitive to the probability of a positive production shock, π, to the availability of information at the time of constitutional choice, and to an individual's labour type and region of residence when known. In general, given π, type B individuals in region 1 and 2 rank constitutions differently and, in general, do not prefer the same constitutions to the no constitution alternative. This result is not unexpected. Since the economy's supply of mobile labour is fixed, different constitutions generally imply a different regional distribution of type A labour. For the chosen parameter values, the utility of type B individuals in either region increases with increases in their region's type A population. Since constitutions redistribute mobile labour relative to the no constitution outcome, one region gains type A workers while the other region loses mobile workers when one of the five constitutions is adopted. This implies that constitutions involve different tradeoffs between higher utility for type B residents in one region and lower utility for immobile residents in the other region. Thus, under these circumstances, constitutional rankings for immobile individuals will differ across regions when individuals know their region of residence.

Table V.4:
Constitutional Rankings: Type A Majorities Exist in Both Regions and Voluntary Transfers Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=2000$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.8$	1>NC>3>5>4>2
	$\pi\geq0.8$	1>3>NC>5>4>2
Type B individuals in region 1	$\pi<0.7$	2>4>5>NC>3>1
	$\pi=0.7$	2>4>NC>5>3>1
	$\pi=0.8$	NC>3>5>4>2>1
	$\pi>0.8$	3>NC>5>4>2>1
Type B individuals in region 2	$0<\pi<0.7$	3>NC>5>4>2>1
	$\pi=0.7$	3>5>NC>4>2>1
	$\pi=0.8$	2>4>5>3>NC>1
	$\pi>0.8$	2>4>5>NC>3>1

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.8$	1>NC>3>5>4>2
	$\pi\geq0.8$	1>3>NC>5>4>2
Type B individuals	4>5>2>NC>3>1	

(c) Production and Labour Type Uncertainty

All individuals	$\pi<1.0$	1>NC>5>3>4>2
	$\pi=1.0$	1>NC>3>5>4>2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximize Output
5 : Optimal Population Distribution
Note: Expected utility is calculated for π in the zero to one range with a step size of .01.

Table V.5:
Constitutional Rankings: Type A Majorities Exist in Both Regions and Voluntary Transfers Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=2000$

(a) Production Uncertainty Only

Type A individuals	1>NC>5>4>3>2	
Type B individuals in region 1	$\pi<0.7$	3>2>4>5>NC>1
	$\pi=0.7$	3>2>4>NC>5>1
	$\pi\geq0.8$	NC>5>4>2>3>1
Type B individuals in region 2	$\pi<0.7$	NC>5>4>2>3>1
	$\pi=0.7$	5>NC>4>2>3>1
	$\pi\geq0.8$	3>2>4>5>NC>1

(b) Production and Region of Residence Uncertainty

Type A individuals	1>NC>5>4>3>2
Type B individuals	2>4>5>NC>3>1

(c) Production and Labour Type Uncertainty

All individuals	1>NC>5>4>2>3

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximize Output
5 : Optimal Population Distribution
Note: Expected utility is calculated for π in the zero to one range with a step size of .01.

Table V.6:
Constitutional Rankings: Type B Majorities Exist in Both Regions and Voluntary Transfers Not Permitted/ Permitted Under Constitution

$L^A=5000,\ L_1^B=L_2^B=3500$

(a) Production Uncertainty Only

Type A individuals	$\pi \leq 0.3$	5>NC>3>4>2>1
	$0.3<\pi<0.7$	5>NC>3>2>4>1
	$\pi=0.7$	5>2>NC>3>4>1
	$\pi>0.7$	2>5>NC>3>4>1
Type B individuals in region 1	$\pi<0.8$	1>2>4>3>NC>5
	$\pi \geq 0.8$	1>5>NC>3>4>2
Type B individuals in region 2	$\pi<0.8$	1>5>NC>3>4>2
	$\pi \geq 0.8$	1>2>4>3>NC>5

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi \leq 0.3$	5>NC>3>4>2>1
	$0.3<\pi<0.7$	5>NC>3>2>4>1
	$\pi=0.7$	5>2>NC>3>4>1
	$\pi>0.7$	2>5>NC>3>4>1
Type B individuals	1>4>3>2>NC>5	

(c) Production and Labour Type Uncertainty

All individuals	$0<\pi<0.6$	1>5>NC>3>4>2
	$\pi=0.6$	1>5>NC>3>2>4
	$\pi>0.6$	1>2>5>NC>3>4

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximize Output
5 : Optimal Population Distribution

Note: Expected utility is calculated for π in the zero to one range with a step size of .01.

Table V.7:
Constitutional Rankings: Type A Majority in Region 1 & Type B Majority in Region 2 and Voluntary Transfers Not Permitted/ Permitted Under Constitution

$L^A=5000,\ L_1^B=1000,\ L_2^B=4000$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.5$	4>NC>3>5>1>2
	$0.5\leq\pi<0.8$	4>NC>5>3>1>2
	$\pi\geq0.8$	4>NC>5>3>2>1
Type B individuals in region 1	$\pi<0.8$	4>NC>5>3>2>1
	$\pi\geq0.8$	4>NC>5>3>1>2
Type B individuals in region 2	$\pi<0.4$	3>5>2>1>NC>4
	$0.4\leq\pi<0.6$	3>2>5>1>NC>4
	$0.6\leq\pi<0.8$	3>2>1>5>NC>4
	$\pi\geq0.8$	3>1>2>5>NC>4

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.5$	4>NC>3>5>1>2
	$0.5\leq\pi<0.8$	4>NC>5>3>1>2
	$\pi\geq0.8$	4>NC>5>3>2>1
Type B individuals	$\pi<0.8$	3>5>NC>4>2>1
	$\pi\geq0.8$	3>5>NC>4>1>2

(c) Production and Labour Type Uncertainty

All individuals	3>5>NC>4>2>1

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximize Output
5 : Optimal Population Distribution

Note: Expected utility is calculated for π in the zero to one range with a step size of .01.

For the numerical example considered, regional majorities have no incentives to make voluntary transfers when type B individuals form the majority in both regions. In this case an increase in a region's share of mobile labour increases disposable income for immobile individuals in the majority and has a positive effect on their utility. Consequently, immobile majorities prefer more type A population to less and have no incentives to make positive interregional transfers, at least in the neighbourhood of this local equilibrium. For the mixed majority population configuration, regional governments also prefer more mobile population to less and therefore have no incentives to make voluntary transfers. Regional majorities' incentives to make voluntary transfers are examined in more detail in chapter IV.

Summary

While the model is highly abstract and the numerical results are simply illustrations, the results show that uncertainty can create incentives for regional majorities to adopt a transfer scheme as a form of insurance. The results also show that the choice of constitution depends on whether the regional majorities are of the same labour type. The availability of information influences the likelihood of reaching a consensus on a particular constitution only if the identity of the majority differs across regions. In the mixed majority case when labour type and region of residence are unknown, regional majorities prefer constitutions that offer some insurance relative to both the no constitution outcome and to constitution 1 which provides the highest degree of insurance coverage. When production alone is uncertain or if both production and region are uncertain, no consensus is obtained and no constitution is chosen. When regional majorities are of the same labour type, majorities always choose the constitution offering the most insurance, constitution 1, relative to the no constitution outcome. Both the efficiency and social optimal constitutions are unlikely to be adopted under these circumstances since neither arrangement provides insurance against utility variations by labour type or region of residence.

Additional sensitivity analysis would be useful especially for the case where the immobile type forms the majority in both regions or perhaps for the mixed majority case. Depending on one's beliefs regarding the interregional mobility of individuals, the former can be thought of as providing a framework for an examination of constitutional or interregional negotiations between Quebec or the Atlantic region and the "Rest of Canada". Alternatively one might view the latter as representing a "Quebec versus the Rest of Canada" scenario if one believes that the majority of Canadian citizens residing outside Quebec are relatively mobile while the Quebec majority is relatively immobile. In this case, the model predicts that a constitution with extensive income sharing is unlikely to be adopted. A rent sharing constitution is the most likely outcome in this case.

In Canada, equalization takes the form of interregional transfers that equalize tax capacity, including the partial equalization of resource rents. Suppose constitutional negotiations are between Quebec and the rest of Canada and that the regional majorities in Quebec and in the rest of Canada are comprised of immobile and mobile individuals respectively. If individuals are ex-ante identical at the time of constitutional negotiations, then the model predicts that a rent sharing constitution would be adopted. This result would be consistent with the type of equalization that currently exists in Canada. If individuals know their labour type at the time of constitutional negotiations, then no constitution is adopted.

V.6 Sensitivity Analysis

In this section, additional analysis is conducted to determine how sensitive constitutional choices are to changes in some parameters. The results in section V.5 demonstrate that the constitutional outcome depends on the population configuration and the identity of each regional majority. To illustrate how the constitutional choice might be affected by small changes in parameter values, we focus on one possible population configuration where the immobile type forms the majority in both regions. The sensitivity analysis is limited to this case for two reasons. Since the model is quite abstract, all population configurations need not be considered in order to illustrate how robust constitutional outcomes are to changes in the model's parameters. In addition, in Canada for example, only a small portion of provincial populations are mobile. Thus, the population configuration where both regional majorities are immobile is not an unlikely characterization.

Type B Majority in Both Regions

The results of the sensitivity analysis are presented in tables V.8 to V.11.

Table V.8:
Summary of Constitutional Choices by Available Information for Different Values of the Production Shock (θ_H and θ_L)

Δ in θ_H and θ_L	Information Set		
	(a) Production Uncertainty Alone	(b) Production and Region of Residence Unknown	(c) Production, Region of Residence and Type Unknown
$\theta_H=1.01$, $\theta_L=0.97$	C1	C1	C1
$\theta_H=1.03$, $\theta_L=0.97$	C1	C1	C1
$\theta_H=1.01$, $\theta_L=0.98$	C1	C1	C1

Individual Rankings shown in tables C9-C16 in Appendix C.

Table V.9:
Summary of Constitutional Choices by Available Information for Different Values of Region 1's Land Endowment (T_1)

Δ in T_1	Information Set		
	(a) Production Uncertainty Alone	(b) Production and Region of Residence Unknown	(c) Production. Region of Residence and Type Unknown
$T^1=4000$	C1	C1	C1
$T^1=4500$	NC	C1	C1
$T^1=5000$	NC	C1	C1

Individual Rankings shown in tables C17-C18 in Appendix C.

Table V.10:
Summary of Constitutional Choices by Available Information for Different Values of Region 1's Endowment of Immobile Labour (L_1^B)

Δ in L_1^B	Information Set		
	(a) Production Uncertainty Alone	(b) Production and Region of Residence Unknown	(c) Production, Region of Residence and Type Unknown
$L_1^B = 3500$	C1	C1	C1
$L_1^B = 3800$	C1	C1	C1
$L_1^B = 4000$	C1	C1	$\pi < 0.6 \rightarrow C1$ $\pi \geq 0.6 \rightarrow C3$

Individual Rankings shown in tables C19-C20 in Appendix C.

Table V.11:
Summary of Constitutional Choices by Available Information for Different Values of the Utility Parameter (ρ)

Δ in ρ	Information Set		
	(a) Production Uncertainty Alone	(b) Production and Region of Residence Unknown	(c) Production, Region of Residence and Type Unknown
$\rho = 0.75$	C1	C1	C1
$\rho = 0.65$	C1	C1	C1
$\rho = 0.60$	C1	C1	$\pi = 0.1 \rightarrow C1$ $\pi > 0.1 \rightarrow C2$

Individual rankings shown in tables C21-C22 in Appendix C.

Table V.8 shows that small variations in the size of the production shocks leave the general pattern of constitution choice unaffected. The first row in table V.8 summarizes the constitutional outcomes for the computed example using the default parameter values given in tables V.2a and V.2b. Although individual rankings, shown in appendix C tables C9 to C16, are sensitive to small changes in the size of the production shock, the pattern of constitution choice appears to be robust with respect to these changes.

In table V.9, the effects of small changes in region 1's endowment of land on the constitutional outcome are examined. It is assumed that the total increase in land is allocated entirely to type B labour in the region. Again, the first row in table V.9 summarizes the constitutional outcomes for the computed example using the default parameter values. The results suggest that the constitutional outcome is sensitive to changes in regional land endowments only for the case where production alone is uncertain. Recall that this is the case where individuals have full information regarding their region of residence and labour type.

The effects of changes in region 1's type B population are examined in table V.10. Since the status quo assumes equal regional type B populations, the effects of moving away from this symmetry are captured by the results shown in table V.10. Again, constitutional outcomes exhibit some sensitivity to small changes in the immobile population parameters. In this case, the constitution that receives unanimous support from regional majorities when individuals are ex-ante identical changes when L_1^B increases. In particular, when L_1^B equals 4000 and the probability that the positive production shock occurs is greater than 0.6, regional majorities agree to adopt the rent sharing constitution. If π is less than 0.6, regional majorities vote unanimously for constitution 1 which provides the most insurance.

Constitutional outcomes for different values of the utility parameter, ρ, are provided in table V.11 under the alternative assumptions regarding the availability of information. ρ measures the relative weight of the private consumption good and the local public good in an individual's utility function. As ρ decreases, the weight placed on the local public good increases. Constitutional outcomes when individuals are ex-ante identical are somewhat sensitive to changes in this parameter. Unless the probability of the positive shock occurring is very low, individuals prefer the income sharing by type constitution, constitution 2, to both the complete income sharing constitution and the no constitution outcome.

The results of this limited sensitivity analysis illustrate that the choice of constitution when the immobile labour type forms the majority in both regions exhibits some sensitivity to small changes in the parameters values. At least in the case where the immobile type forms the majority in both regions, the complete income sharing constitution receives unanimous support for a number of different parameter values and when some information regarding region of residence or labour type is available at the time of constitutional negotiations.

V.7 Conclusions

In this chapter the basic model developed in chapters III and IV is extended to include production uncertainty in the form of a production shock in region 1. Rather than exogenously imposing a federal or central government with powers over regional governments as is presumed in most of this literature, a constitutional choice framework allows for a federal authority to arise endogenously within the model.

With the introduction of production shocks into a fiscal externality framework, the hypothesis that production uncertainty creates incentives to adopt some form of interregional transfers as a form of social insurance is examined. The model also considers the effects of uncertainty with respect to labour type and region of residence in addition to production uncertainty and the effects of these additional sources of uncertainty on the type of transfer scheme that might be adopted. The problem is loosely modelled as a constitutional choice or design problem where regional majorities can vote to adopt a transfer scheme before the state of the world is known. The transfer scheme is assumed to take the form of a binding constitution that governs the behaviour of a federal authority created to carry out the constitutionally-specified responsibilities. While abstracting from a number of important factors and influences that shape a federal government system, the model attempts to examine an alternative rationale for interregional transfers based on social insurance principles rather than pure efficiency considerations in a environment where two orders of government exist.

The model shows that uncertainty can create incentives to adopt a constitution as a form of insurance (and a federal structure) and that the type of insurance depends on the identity of the majority in each region as well as the availability of information at the time of constitutional choice. The numerical examples, while merely illustrative, clearly indicate that regional majorities under some circumstances will unanimously adopt some form of interregional transfers scheme. In addition, the numerical examples suggests that neither a constitution that maximizes output nor one that ensures a socially optimal population distribution is likely to be adopted. The implication of the model is that the costs of these constitutions outweigh the benefits for at least one regional majority and hence both constitutions fail to achieve unanimous regional support. The most likely constitution to be adopted when regional majorities are of the same type is the constitution that fully insures individuals against variations in utility with respect to labour type or region of residence in the migration equilibrium once the production shock is known. The numerical examples show that in the migration equilibrium with the complete income sharing constitution and no voluntary transfers, regions are of the same size and offer identical fiscal packages. When regional majorities differ, consensus is less likely. In this case, a rent sharing constitution is most likely to be adopted rather than the complete income sharing constitution. The sensitivity analysis indicates that the complete income sharing constitution that offers full ex-post insurance is the predominant choice and that constitutional choices are not highly sensitive to small changes in the parameter values, at least for the case where the immobile labour type forms the majority in both regions.

These results suggest some interesting predictions about the future of the Canadian constitution and equalization after the upcoming Quebec referendum. Suppose Quebec opts for economic association and is no longer entitled to equalization under the constitution. A renegotiation of the constitution and interregional transfers may be prompted by this event. Suppose that the remaining provinces are considered similar (regional majorities are of the same identity). This analysis predicts a renegotiation of equalization may result in a greater move toward income sharing through federally-administered transfers. On the other hand, suppose that the majority of individuals in the Atlantic region are relatively immobile while individuals in the remaining provinces are mobile. In this case, a renegotiation is unlikely to result in a constitution with more extensive income sharing and the status quo may prevail.

While the model developed in this chapter cannot predict the outcome of constitutional negotiations with any certainty, the model can suggest some of the factors and influences at work when choosing interregional transfers as part of a constitutional design. Extending the model to consider interregional transfers and constitutional choice in a dynamic setting, the model could investigate how the identities of the original participants affects the initial constitutional choice and how the constitution might evolve over time in response to shocks.

Chapter VI. Conclusions

This thesis undertakes to extend the literature on interregional transfers by introducing a number of characteristics that are often omitted from the traditional fiscal externality models developed to investigate such transfers. Early contributions to the fiscal externality literature demonstrate that decentralized government decision-making in the presence of mobile individuals can lead to fiscal differences across regions and, as a result, a suboptimal distribution of labour. In these models, a lump sum interregional transfer is necessary to achieve an optimal population distribution. Recent contributions to this literature examine under what conditions these interregional transfers are made voluntarily by regional governments rather than a central authority and whether these voluntary transfers are sufficient to restore efficiency in the allocation of mobile labour. As such, fiscal externality models have been used to explain the existence of interregional transfers or equalization in federal systems and the direction of these transfers.

While the fiscal externality literature makes an important contribution to the theory of interregional transfers, several important characteristics of federal systems are often overlooked in these models. As demonstrated in chapter II of this thesis, the issue of intraregional diversity is ignored in this literature with few exceptions. In reality, diversity within regions has an important influence on how regional government's decisions are made and on the outcome of regional government decisions. By adopting the assumption of regional homogeneity, the effects of intraregional diversity on public goods provision, on the regional distribution of population and on the incentives of regional governments' to make voluntary interregional transfers cannot be determined. Intraregional preference diversity and its' effects on the provision of local public goods are examined in the majority voting literature but individual income is exogenous in these models. Since the endogenous determination of income is a key feature of the fiscal externality environment, existing majority voting models cannot address the issues of preference diversity and public goods provision in a fiscal externality setting.

Another important feature of federal systems is the presence of different orders of government each with its own powers and responsibilities. While the fiscal externality literature often concludes that centrally-coerced interregional transfers are required to achieve efficiency, regional participation in these transfers cannot be explained in the context of these fiscal externality models. For example, this literature does not provide a complete explanation for the willingness of the Canadian provinces to participate in, or for the type of interregional transfer that is made under, Canada's fiscal equalization program. Equity and social insurance considerations are often cited as alternative rationales for equalization but these alternatives have received little attention in the economics literature on fiscal federalism. Chapter II also demonstrates the lack of formal treatment of these alternative rationales for interregional transfers in the literature and the tendency in the literature to presume the existence of an exogenous external authority.

The principle of equalization or interregional transfers is enshrined in Canada's *Constitution Act, 1982* and, while this example provides some evidence that interregional transfers could be examined from a constitutional perspective, this approach has not been explored in the fiscal externality literature. Recent contributions to the literature on the optimal design of constitutions examine this possibility. These models do not, however, incorporate intraregional diversity or public goods and, as such, fail to capture the important interactions between public goods provision, regional government decision-making and interregional transfers.

The research in this thesis undertakes to narrow the gap between the theory and the practice of interregional transfers. Intraregional diversity, the endogenous determination of a federal government structure and constitutionally-mandated interregional transfers, are introduced into a fiscal externality model and an alternative rationale for equalization, namely the social insurance rationale, is examined. These important features of federal systems and their effects on public goods provision and migration externalities are often omitted from the traditional fiscal externality models.

In chapter III, intraregional diversity is introduced into the standard fiscal externality model and, to reconcile this diversity, a majority voting rule is adopted to govern regional government decision-making. Since regional homogeneity is often assumed in the literature, the impact of majority voting on public goods provision and the migration equilibrium has not yet been examined in a fiscal externality framework. The model shows that public goods provision and the equilibrium distribution of labour are seldom optimal when fiscal decisions are determined by majority voting. Public goods provision and the migration equilibrium are shown to be dependent on assumptions regarding individual and regional government myopia when uniform head taxes are used to finance public expenditures. In contrast, the fiscal externality literature demonstrates that, while the regional distribution of population is generally suboptimal, public goods are optimally provided according to the traditional Samuelson rule and myopia assumptions do not affect the migration equilibrium given an identical method of financing.

By introducing intraregional diversity and majority voting in a fiscal externality model, the fiscal externality literature is extended as public goods provision and migration externalities are examined in a richer structure. The analysis demonstrates the importance of behaviourial assumptions, like myopia and the assumptions regarding the method of financing public expenditures, for predictions concerning the optimality of public goods provision and the distribution of population and the necessity and type of corrective transfers required to restore efficiency. While majority voting models examine public goods provision in a framework with intraregional diversity, migration and majority voting, income is assumed to be independent of an individual's location. The model developed in this chapter is similar in that public goods provision is considered in a model with majority voting, intraregional diversity and mobility but where income is endogenous. Thus, the analysis in chapter III extends the literature on public goods provision and majority voting and links it with the fiscal externality literature.

Recent work in the fiscal externality literature examines regional governments' incentives to make voluntary transfers, perhaps eliminating the role of a national authority in making efficiency-enhancing transfers. In these models, strong incentives to make voluntary transfers are related to the assumptions of perfect mobility and individual homogeneity. These two assumptions are relaxed and regional incentives to make transfers, both within and across regions, when regional fiscal decisions are determined by majority voting are examined in chapter IV.

Chapter IV shows that, under certain conditions regarding relative incomes and the identity of regional majorities, regional minorities have incentives to make voluntary income transfers to regional majorities in order to influence the choice of fiscal package within the region. Abstracting from problems of free riding and enforcement, these intraregional transfers from minority to majority individuals serve as a means of circumventing the uniform taxation constraint imposed on regional governments. In exchange for an adjustment in the region's fiscal package, the regional minority agrees to pay higher taxes. In fiscal externality models where individuals are assumed to be homogeneous, there is no need to examine the incentives for voluntary intraregional transfers of this nature. Chapter IV indicates that once intraregional diversity is permitted decisions affecting regional public goods provision require more careful examination.

The analysis in chapter IV demonstrates that regional majorities have, under certain conditions, incentives to voluntarily transfer income to individuals outside the region. The migration equilibrium is necessarily characterized by voluntary interregional transfers only if both regional majorities are comprised of perfectly mobile individuals in equilibrium. The model shows that the distribution of population is not optimal and voluntary interregional transfers, if made, do not restore efficiency in the allocation of labour across regions. Recent contributions to the fiscal externality literature find similar results, showing that voluntary transfers need not occur in the migration equilibrium and do not necessarily achieve the optimal distribution of labour. Myers (1990) represents the exception to this result and demonstrates that if individuals are identical and perfectly mobile then the voluntary transfers made in equilibrium are sufficient to achieve an optimal distribution of population.

Although some attention is directed at whether centrally-coerced transfers to individuals can restore efficiency if these transfers discriminate either on the basis of region of residence or personal characteristics or both, the fiscal externality literature makes no distinction between transfers made directly to individuals and transfers made to regional governments. Since the assumption of individual homogeneity is often adopted in this literature, there is no need to distinguish between the incentives of regional governments and of regional residents to accept a transfer. In chapter IV, the analysis concludes that transfers to individuals are not equivalent to transfers to governments when intraregional diversity and majority voting are introduced into a fiscal externality model. Since the preferences of the regional majority generally differ from the preferences of those individuals in the minority, there may be disagreement within the region over the benefits of accepting an income transfer. The model shows that if transfers are made directly to individuals then each individual acting in their own self interest accepts the transfer. In equilibrium, the net effect of the transfer may, however, be to reduce the utility of individuals in the majority. If, on the other hand, transfers are made to regional governments who must share it equally among all residents, then regional majorities accept a transfer only if it improves the utility of the majority. Thus, the analysis establishes the importance of assumptions regarding the mechanism by which voluntary transfers are made to public goods provision and the distribution of resources in fiscal externality models.

With the introduction of uncertainty in chapter V, the model focuses on the incentives of regional majorities to adopt a constitutionally-mandated interregional transfer scheme. In contrast to the traditional fiscal externality models, this model allows for the endogenous determination of a federal government structure where interregional transfers are considered part of the constitutional design. While the Canadian example provides some evidence that interregional transfers can be viewed from a constitutional perspective, until now, this approach has not been pursued in the context of a fiscal externality model. The model considers how the identity of the majority in each region influences the choice of constitution when constitutional decisions are determined before the uncertainty is resolved. The effects of the availability of information on the constitutional outcome are also examined.

The numerical results show that regional majorities have incentives to adopt some form of federally-administered interregional transfers when faced with uncertainty. If regional majorities are comprised of the same type of individuals, then a constitution that provides full ex-post insurance against variations in utility is adopted. Numerical simulations indicate that this constitutional choice is independent of the information available at the time of constitutional negotiations. If the identities of regional majorities differ, then unanimous agreement by regional majorities to a particular constitution is more difficult to achieve. In this case, a constitution is adopted only if individuals have no information regarding their labour type or region of residence at the time of constitutional negotiations and this choice provides only partial ex-post insurance against utility variations. A sensitivity analysis shows these results to be fairly robust with respect to small changes in the model's parameters.

While the traditional fiscal externality literature often concludes that centrally-coerced interregional transfers are necessary to restore efficiency in the allocation of labour, the central or external authority required to make these transfers is assumed to be exogenous to the model. Rather than adopt the assumption of an exogenous federal authority, chapter V shows that, under certain conditions, a federal government evolves endogenously as a response to uncertainty faced by regional majorities. Moreover, the federally-administered interregional transfer scheme in which regional majorities willingly participate depends on the identity of regional majorities and the availability of information at the time of constitutional choice. This model explores an alternative to the efficiency rationale to equalization and, in doing so, extends the fiscal externality literature and links it with the literature on the optimal constitutional design where the effects of uncertainty and risk aversion on income sharing and constitutional choice are examined.

The major contributions of this thesis to the literature on interregional transfers are summarized above. In addition, the basic model developed in chapter III and extended in chapters IV and V can be further extended in several interesting directions. For example, a richer tax structure could be introduced into the model presented in chapter III to examine public goods provision given majority voting and location-dependent income. It would be interesting to consider the implications for public goods provision of a move away from the assumption of uniform taxation to taxation based on income in a fiscal externality setting with majority voting. The effects of non-uniform taxation on regional minorities' and majorities' incentives to make intraregional and interregional transfers respectively could also be explored by extending the model developed in chapter IV.

This thesis adopts the standard assumption that regional majorities are Nash competitors. In countries such as Canada where the number of "regions" is small and regional governments have a significant amount of power vis-a-vis the federal government, this assumption seems restrictive. Alternatives to the Nash assumption represent an interesting extension to consider especially when examining regional majorities' incentives to make voluntary interregional transfers or to adopt a particular constitution.

Dynamics could be introduced into the model developed in chapter V to investigate how the identities of the original participants affects the constitutional outcome and how the constitution might evolve over time. Costs of constitutional negotiations and costs to defections from the constitution could be included to examine the stability of constitutions in a fiscal externality framework.

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Appendix A

To simplify the model developed in this thesis, interactive effects between labour inputs in production are not permitted. The results of this analysis carry over, however, when a more generalized production function is adopted. To see this, consider the following production function:

$$(A1) \qquad y_i = (T_i)^{\alpha}(L_i^{A})^{\beta}(L_i^{B})^{\gamma} \quad ,$$

where $\alpha+\beta+\gamma=1$ and where $\beta+\gamma<1$. In contrast to the production function given by equation (III.2), equation (A1) permits interactive effects between labour inputs. The production technology described in equation (A1) exhibits constant returns to scale in all inputs and both labour inputs are subject to diminishing returns as is the case using the production function in chapter III. Given A1, the marginal products of type A and type B labour respectively are:

$$(A2) \qquad F_i^{A} = \beta(T_i)^{\alpha}(L_i^{A})^{(\beta-1)}(L_i^{B})^{\gamma} \quad ,$$

and

$$(A3) \qquad F_i^{B} = \gamma(T_i)^{\alpha}(L_i^{A})^{\beta}(L_i^{B})^{(\gamma-1)} \quad .$$

Rents generated on a region's endowment of land are:

$$(A4) \qquad R_i = (1-\beta-\gamma)(T_i)^{\alpha}(L_i^{A})^{\beta}(L_i^{B})^{\gamma} \quad .$$

The main results of this thesis relate to the decision rules for fiscal choices when regional decision-making is governed by majority voting. Thus, while the form of the production function affects the migration equilibrium and the solutions to the endogenous variables in equilibrium, the decision rules are unaffected. Consider the model developed in chapter III to examine public goods provision given majority voting under alternative myopia and mobility assumptions. Now, consider the case where type A individuals are mobile, type B individuals are immobile and output is produced according to equation (A1). A myopic majority chooses the level of public good to maximize the utility of a representative individual of the majority type. The first order condition to this optimization problem given (A1) is identical to equation (III.14), the myopic decision rule when interactive effects are prohibited. Similarly, a non-myopic majority's decision rule for public goods provision given (A1) is identical to equation (III.25). Although regional levels of public goods provision are likely to differ, the myopic and non-myopic *rules* for public goods provision when interactive effects between labour inputs in production are permitted are identical to the rules derived given the more restrictive production function adopted in chapter III.

To illustrate this conclusion, consider the two propositions derived in chapter III. Proposition 1 states that, if the mobile type forms the majority in both regions, the migration equilibrium is the same whether individuals are assumed to be myopic or non-myopic with respect the migration effects of their decisions. In contrast, proposition 2 states that if the immobile type forms the majority in at least one region myopia assumptions matter for public goods provision and the migration equilibrium. Since the form of the provision rules are independent of the type of production function adopted, it is obvious that these results continue to hold for the more general case where the production function permits interactive effects between labour types.

As is the case with chapter III, the models developed in chapters IV and V focus on the decision rules for the fiscal choices of regional majorities in alternative settings. The first order conditions to regional majorities' and minorities' respective optimization problems are unchanged when the production function given by equation (A1) is adopted. In conclusion, the major results of this thesis relate to the decision-making process or rules for fiscal choices given majority voting rather than the values taken on by the endogenous variables in equilibrium. Therefore, the exclusion of interactive effects in production leaves the propositions and conclusions derived in chapters III to VI unchanged.

Appendix B

The analysis presented in chapters III, IV and V of this thesis assumes that the conditions necessary to ensure the existence of an unique migration equilibrium are satisfied. As is demonstrated below, these conditions can be derived explicitly only for the case where the majority in each region is comprised of perfectly mobile individuals. For the case where a myopic or non-myopic type B majority exists in at least one region, the model's complexity prevents a tractable derivation of the necessary conditions.

Migration Equilibrium With Myopic, Majority Voting: Existence of Equilibrium

Consider the basic model developed in chapter III. If the conditions for the implicit function theorem are satisfied, then the equilibrium solutions for regional expenditures on public goods and the distribution of mobile population, G_1, G_2 and L_1^A, are determined by the three equation system below:

(III.14.1)
$$ {}_1U_G^{l} - \frac{{}_1U_x^{l}}{L_1^A + L_1^B} = 0 \quad , $$

(III.14.2)
$$ {}_2U_G^{m} - \frac{{}_2U_x^{m}}{L^A - L_1^A + L_2^B} = 0 \quad , $$

(III.7) $$U(x_1^A,\ G_1) - U(x_2^A,\ G_2) = 0 \quad ,$$

where t and m represent the labour type to form the majority in regions 1 and 2 respectively. Rewriting the above system, we obtain:

$$H^1(G_1, L_1^A;\ L^A, L_1^B, L_2^B, T_1, T_2) = 0 \quad ,$$

$$H^2(G_2, L_1^A; L^A, L_1^B, L_2^B, T_1, T_2) = 0 \quad ,$$

$$H^3(G_1, G_2, L_1^A; L^A, L_1^B, L_2^B, T_1, T_2) = 0 \quad .$$

The implicit function theorem says that if H^1, H^2, and H^3 have continuous partial derivatives and the Jacobian determinant to the above system of equations is non-zero, then these three implicit functions can be used to solve for the three endogenous variables, G_1, G_2 and L_1^A.

To satisfy the conditions of the theorem and to ensure existence of a unique equilibrium, the determinant of the Jacobian matrix, $|J|$, for the above system of equations must be nonzero where $|J|$ equals:

$$|J| = \begin{vmatrix} \frac{\partial H^1}{\partial G_1} & \frac{\partial H^1}{\partial G_2} & \frac{\partial H^1}{\partial L_1^A} \\ \frac{\partial H^2}{\partial G_1} & \frac{\partial H^2}{\partial G_2} & \frac{\partial H^2}{\partial L_1^A} \\ \frac{\partial H^3}{\partial G_1} & \frac{\partial H^3}{\partial G_2} & \frac{\partial H^3}{\partial L_1^A} \end{vmatrix} \neq 0 \quad ,$$

and

$$\frac{\partial H^1}{\partial G_1} = {}_1U^l_{GG} - \frac{2\,{}_1U^l_{Gx}}{L_1^A + L_1^B} + \frac{{}_1U^l_{xx}}{(L_1^A + L_1^B)^2} < 0 \;\; \textit{by second order conditions} \quad ,$$

$$\frac{\partial H^1}{\partial G_2} = 0 \quad ,$$

$$\frac{\partial H^1}{\partial L_1^A} = \frac{\partial x_1^l}{\partial L_1^A}\left({}_1U^l_{Gx} - \frac{{}_1U^l_{xx}}{L_1^A + L_1^B} \right) + \frac{{}_1U^l_x}{(L_1^A + L_1^B)^2} \quad ,$$

$$\frac{\partial H^2}{\partial G_1} = 0 \quad ,$$

$$\frac{\partial H^2}{\partial G_2} = {}_2U^m_{GG} - \frac{2\,{}_2U^m_{Gx}}{L^A - L_1^A + L_2^B} + \frac{{}_2U^m_{xx}}{(L^A - L_1^A + L_2^B)^2} < 0 \;\; \textit{by second order conditi}$$

$$\frac{\partial H^{2}}{\partial L_1^{A}} = \frac{\partial x_2^{A}}{\partial L_1^{A}}\left(-{}_2U_{Gx}^{m} + \frac{{}_2U_{xx}^{m}}{L^{A}-L_1^{A}+L_2^{B}} \right) - \frac{{}_2U_x^{m}}{(L^{A}-L_1^{A}+L_2^{B})^2} \quad ,$$

$$\frac{\partial H^{3}}{\partial G_1} = \left({}_1U_G^{A} - \frac{{}_1U_x^{A}}{L_1^{A} + L_1^{B}} \right) = 0 \quad \mathit{if}\ t = A$$

$$\overset{\geq}{<} 0 \ \mathit{if}\ t = B \quad ,$$

$$\frac{\partial H^{3}}{\partial G_2} = -\left({}_2U_G^{A} - \frac{{}_2U_x^{A}}{L^{A} - L_1^{A} + L_2^{B}} \right) = 0 \quad \mathit{if}\ m = A$$

$$\overset{\geq}{<} 0 \ \mathit{if}\ m = B \quad ,$$

$$\frac{\partial H^{3}}{\partial L_1^{A}} = {}_1U_x^{A}\left(\frac{\partial x_1^{A}}{\partial L_1^{A}} \right) - {}_2U_x^{A}\left(\frac{\partial x_2^{A}}{\partial L_1^{A}} \right) \quad .$$

In general, the expression for |J| is not easily evaluated. The difficulty arises with the elements $\partial H^3/\partial G_1$ and $\partial H^3/\partial G_2$, the partial derivatives of the equal utilities condition with respect to the public good in each region. Suppose t=A and m=A such that type A individuals form the majority in both regions. In this case, the expression for $\partial H^3/\partial G_i$ is identical to the first order condition for region i's choice of G_i (i.e. equation (III.14)). Since G_i is chosen to ensure this condition equals zero in equilibrium, $\partial H^3/\partial G_1$ equals zero. |J| can therefore be written as:

$$|J| = \left({}_1U_x^A \frac{\partial x_1^A}{\partial L_1^A} - {}_2U_x^A \frac{\partial x_2^A}{\partial L_1^A} \right) \left({}_1U_{GG}^A - 2\frac{{}_1U_{Gx}^A}{L_1^A + L_1^B} + \frac{{}_1U_{xx}^A}{(L_1^A + L_1^B)^2} \right)$$
$$\times \left({}_2U_{GG}^A - \frac{2\,{}_2U_{Gx}^A}{L^A - L_1^A + L_2^B} + \frac{{}_2U_{xx}^A}{(L^A - L_1^A + L_2^B)^2} \right) .$$

Necessary and sufficient conditions for $|J| \neq 0$ are that the three bracketed expressions are nonzero. The second and third terms of |J| equal the second order condition to region 1 and 2's optimization problem respectively. If the utility function is strictly quasiconcave, then both these expressions are strictly negative. To ensure |J| is nonsingular, the additional restriction:

$${}_1U_x^A \left(\frac{\partial x_1^A}{\partial L_1^A} \right) - {}_2U_x^A \left(\frac{\partial x_2^A}{\partial L_1^A} \right) < 0 ,$$

is required. If stability of the migration equilibrium is imposed so as to prevent complete depopulation of type A labour from any one region, then the above expression is negative.[65] This stability condition is also discussed in Stiglitz (1977), Boadway and Flatters (1982) and Myers (1990). Assuming stability and a strictly quasiconcave utility function, |J| is negative and the sufficient conditions for existence of an unique equilibrium are satisfied when a type A majority exists in both regions.

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[65] This expression is obtained by taking the derivative of the equal utilities condition with respect to L_1^A. Suppose $U(x_1^A,G_1) - U(x_2^A,G_2)$ is positive. If $\partial(U(\cdot) - U(\cdot))/\partial L_1^A$ is positive, then this utility differential becomes larger causing further in-migration of type A individuals to region one. This leads eventually to the complete depopulation of type A individuals from region two. A sufficient condition for stability of the migration equilibrium is that per capita rents are larger than per capita taxes in each region, or in other words, land is scarce and the economy is not "underpopulated". For further discussion of this condition, see Stiglitz (1977).

If a type B majority exists in region i, then $\partial H^3/\partial G_i$ may be greater, less than or equal to zero. The sign and magnitude of this partial derivative depends on the intraregional income differential between type A and B individuals in region i and the parameters of the model. In this case, the expression for |J| is not easily evaluated and it is necessary to assume the conditions required for existence are satisfied in the case where a type B majority exists in at least one region.

Migration Equilibrium With Non-myopic, Majority Voting: Existence of Equilibrium

As above, assuming the conditions for the implicit function theorem are satisfied, then the equilibrium solutions for regional expenditures on public goods and the distribution of mobile population, G_1, G_2 and L_1^A, when regional majorities are non-myopic are determined by the three equation system below:

(III.25.1)
$$ {}_1U_G^l - \frac{{}_1U_x^l}{L_1^A + L_1^B} + {}_1U_x^l \frac{\partial x_1^l}{\partial L_1^A} \frac{\partial L_1^A}{\partial G_1} = 0 \quad , $$

(III.25.2)
$$ {}_2U_G^m - \frac{{}_2U_x^m}{L^A - L_1^A + L_2^B} + {}_2U_x^m \frac{\partial x_2^m}{\partial L_1^A} \frac{\partial L_1^A}{\partial G_2} = 0 \quad , $$

(III.7) $$U\left(x_1^A,\ G_1\right) - U\left(x_2^A,\ G_2\right) = 0 \quad ,$$

where t and m represent the labour type to form the majority in regions 1 and 2 respectively. The above system can be expressed as follows:

$$V^1\left(G_1, L_1^A;\ L^A, L_1^B, L_2^B, T_1, T_2\right) = 0 \quad ,$$

$$V^2\left(G_2, L_1^A; L^A, L_1^B, L_2^B, T_1, T_2\right) = 0 \quad ,$$

$$V^3\left(G_1, G_2, L_1^A; L^A, L_1^B, L_2^B, T_1, T_2\right) = 0 \quad .$$

If the conditions of the implicit function theorem are satisfied, then V^1, V^2 and V^3 can be used, in principle, to determine the non-myopic migration equilibrium solutions for G_1, G_2 and L_1^A.

As is the case for the myopic equilibrium, the Jacobian determinant given below must be non-zero to ensure the existence of a unique equilibrium:

$$|J| = \begin{vmatrix} \frac{\partial V^1}{\partial G_1} & \frac{\partial V^1}{\partial G_2} & \frac{\partial V^1}{\partial L_1^A} \\ \frac{\partial V^2}{\partial G_1} & \frac{\partial V^2}{\partial G_2} & \frac{\partial V^2}{\partial L_1^A} \\ \frac{\partial V^3}{\partial G_1} & \frac{\partial V^3}{\partial G_2} & \frac{\partial V^3}{\partial L_1^A} \end{vmatrix} \neq 0 \quad .$$

If type A individuals form the majority in both regions, the non-myopic decision rules for public goods provision collapse to the myopic decision rules as demonstrated in chapter III. Therefore, as long as the stability condition is met, a unique migration equilibrium exists for this case. If, however, a type B majority exists in at least one region, $|J|$ depends on the parameters of the model and, in general, cannot be signed. Therefore, the conditions necessary to ensure $|J| \neq 0$ are assumed to be satisfied for the analysis presented in chapters III.

The basic model developed in chapter III is extended in both chapters IV and V. With these extensions, the complexity of the model is increased making impossible the evaluation of the Jacobian determinant for the system of equations determining the migration equilibrium. Thus, it is necessary to assume that the conditions necessary for existence are satisfied for the analysis presented in these chapters as well.

Endogeneity of Regional Majorities

The endogenous determination of regional majorities can also lead to problems of instability and non-existence of equilibrium. These issues are sidestepped in this thesis since the analytical discussion focuses on the migration equilibrium under alternative population configurations and by assuming these population configurations are such that majority switching problems and instability are ruled out. While these issues are both interesting and challenging, the basic and extended models developed here cannot adequately address these issues.

Appendix C

Table C1:

Type A Majority in Both Regions/ No Voluntary Transfers Permitted
Computed Equilibrium
$\theta_k = 0.97$, $L^A = 5000$, $L_1^B = L_2^B = 2000$

	NC	C1	C2	C3	C4	C5
L_1^A	2350.4	2500.0	2500.0	2323.6	2423.9	2367.2
L_2^A	2649.6	2500.0	2500.0	2676.4	2576.1	2632.8
y_1	4043.1	4109.0	4109.0	4031.1	4075.7	4050.6
y_2	4302.0	4236.1	4236.1	4313.6	4269.9	4294.7
G_1	992.0	1043.1	1017.1	987.5	1004.3	994.8
G_2	1042.6	1043.1	1017.1	1047.3	1030.1	1039.8
$TR_{12}-TR_{21}$	.0011	----	----	----	----	----
$U(x_1^A, G_1)$	4.22124	4.3278	4.2200	4.22116	4.2205	4.2210
$U(x_2^A, G_2)$	4.22124	4.3278	4.2200	4.22116	4.2205	4.2210
$U(x_1^B, G_1)$	4.3942	4.3278	4.4604	4.3825	4.4254	4.4014
$U(x_2^B, G_2)$	4.5263	4.3278	4.4604	4.5372	4.4966	4.4519
ϕ_1^A		0.037				
ϕ_2^A		0.009				
ϕ_1^B		-0.014				
ϕ_2^B		-0.043				
ϕ^A			+34.42			
ϕ^B			+29.12			
ϕ^R				-11.150		
ϕ^y					-30.448	
ϕ^*						-6.9541

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C2:

Type A Majority in Both Regions/No Voluntary Transfers Permitted Computed Equilibrium

$\theta_k = 1.01$, $L^A = 5000$, $L_1^B = L_2^B = 2000$

	NC	C1	C2	C3	C4	C5
L_1^A	2533.2	2500.0	2500.0	2557.8	2524.9	2543.5
L_2^A	2466.8	2500.0	2500.0	2442.2	2475.1	2456.5
y_1	4302.3	4278.4	4278.4	4304.4	4289.6	4298.0
y_2	4212.1	4236.1	4236.1	4210.0	4224.9	4216.6
G_1	1047.0	1064.3	1037.8	1047.8	1042.1	1045.3
G_2	1028.6	1064.3	1037.8	1027.8	1033.5	1030.3
TR_{12}-TR_{21}	-1.813	----	----	----	----	----
$U(x_1^A,G_1)$	4.3058	4.4157	4.3057	4.3058	4.3057	4.3058
$U(x_2^A,G_2)$	4.3058	4.4157	4.3057	4.3058	4.3057	4.3058
$U(x_1^B,G_1)$	4.5748	4.4157	4.5510	4.5767	4.5628	4.5707
$U(x_2^B,G_2)$	4.5271	4.4157	4.5510	4.5251	4.5392	4.5313
ϕ_1^A		0.019				
ϕ_2^A		0.028				
ϕ_1^B		-0.034				
ϕ_2^B		-0.025				
ϕ^A			-11.47			
ϕ^B			-9.707			
ϕ^R				+3.7718		
ϕ^y					10.150	
ϕ^*						2.3064

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C3:

Type A Majority in Both Regions/ Voluntary Transfers Permitted
Computed Equilibrium
$\theta_k=0.97$, $L^A=5000$, $L_1^B = L_2^B = 2000$

	NC	C1	C2	C3	C4	C5
L_1^A	2350.4	2450.9	2246.3	2572.6	2423.9	2367.8
L_2^A	2649.6	2549.1	2753.7	2427.4	2576.1	2632.2
y_1	4043.1	4087.6	3996.1	4140.3	4075.7	4050.9
y_2	4302.0	4257.9	4346.7	4203.3	4269.9	4294.4
G_1	992.0	1034.7	973.4	1029.4	1004.4	995.0
G_2	1042.6	1051.7	1059.4	1004.8	1030.1	1039.6
TR_{12}-TR_{21}	+0.001	-11.38	-57.12	-42.58	-2910841	375332
$U(x_1^A,G_1)$	4.2212	4.3281	4.2182	4.2198	4.2205	4.2210
$U(x_2^A,G_2)$	4.2212	4.3281	4.2182	4.2198	4.2205	4.2210
$U(x_1^B,G_1)$	4.3942	4.3281	4.4593	4.4859	4.4254	4.4016
$U(x_2^B,G_2)$	4.5253	4.3281	4.4661	4.4326	4.4961	4.5192
ϕ_1^A		0.030				
ϕ_2^A		0.0164				
ϕ_1^B		-0.017				
ϕ_2^B		-0.041				
ϕ^A			-55.41			
ϕ^B			+1.699			
ϕ^R				+49.44		
ϕ_x^y					2910811	
ϕ_x^*						-375339

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C4:

Type A Majority in Both Regions/ Voluntary Transfers Permitted
Computed Equilibrium
$\theta_k = 1.01$, $L^A = 5000$, $L_1^B = L_2^B = 2000$

	NC	C1	C2	C3	C4	C5
L_1^A	2553.2	2516.0	2583.9	2476.2	2524.9	2543.2
L_2^A	2446.8	2484.0	2416.1	2523.8	2475.1	2456.8
y_1	4302.3	4285.7	4316.0	4267.7	4289.6	4297.9
y_2	4212.1	4228.9	4198.2	4246.7	4224.9	4216.6
G_1	1047.0	1067.2	1052.2	1033.7	1042.1	1045.2
G_2	1028.6	1061.5	1023.2	1041.9	1033.5	1030.4
TR_{12}-TR_{21}	-1.813	3.794	+19.35	+14.20	-189695	70897
$U(x_1^A,G_1)$	4.3058	4.4157	4.3055	4.3056	4.3057	4.3058
$U(x_2^A,G_2)$	4.3058	4.4157	4.3055	4.3056	4.3057	4.3058
$U(x_1^B,G_1)$	4.5748	4.4157	4.5524	4.5419	4.5628	4.5706
$U(x_2^B,G_2)$	4.5271	4.4157	4.5501	4.5598	4.5392	4.5314
ϕ_1^A		0.021				
ϕ_2^A		0.026				
ϕ_1^B		-0.033				
ϕ_2^B		-0.025				
ϕ^A			+18.95			
ϕ^B			-0.446			
ϕ^R				-16.49		
ϕ_v^y					189705	
ϕ_v^*						-70894

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C5:

Type B Majority in Both Regions/ Voluntary Transfers Permitted/Not Permitted Computed Equilibrium

$\theta_k = 1.01$, $L^A = 5000$, $L_1^B = L_2^B = 3500$

	NC	C1	C2	C3	C4	C5
L_1^A	2551.7	2500.0	2500.05	2543.0	2524.9	2554.2
L_2^A	2448.3	2500.0	2499.95	2457.0	2475.1	2445.8
y_1	4953.9	4930.6	4930.7	4950.0	4941.8	4955.0
y_2	4858.6	4881.8	4881.8	4862.5	4870.7	4857.4
G_1	1197.9	1226.6	1184.3	1195.6	1190.8	1198.6
G_2	1170.9	1226.6	1184.4	1173.2	1178.0	1170.2
TR_{12}-TR_{21}	0	0	0	0	0	----
$U(x_1^A,G_1)$	4.3002	4.1012	4.3001	4.30019	4.3001	4.3002
$U(x_2^A,G_2)$	4.3002	4.1012	4.3001	4.30019	4.3001	4.3002
$U(x_1^B,G_1)$	3.9760	4.4012	3.9558	3.9724	3.9647	3.9771
$U(x_2^B,G_2)$	3.9355	4.4012	3.9558	3.9392	3.9467	3.9344
ϕ_1^A		-0.045				
ϕ_2^A		-0.036				
ϕ_1^B		0.025				
ϕ_2^B		0.033				
ϕ^A			-10.66			
ϕ^B			-13.73			
ϕ^R				-4.2800		
ϕ^y					13.2783	
ϕ^*						-1.2689

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C6:

Type B Majority in Both Regions/ Voluntary Transfers Permitted/Not Permitted
Computed Equilibrium
$\theta_k=0.97$, $L^A=5000$, $L_1^B = L_2^B = 3500$

	NC	C1	C2	C3	C4	C5
L_1^A	2342.0	2500.0	2499.9	2368.4	2423.9	2334.4
L_2^A	2658.0	2500.0	2500.1	2631.6	2576.1	2665.6
y_1	4665.7	4735.4	4735.3	4677.5	4702.1	4662.3
y_2	4951.4	4881.8	4881.9	4939.9	4915.6	4954.7
G_1	1120.6	1202.1	1161.0	1127.4	1141.7	1118.6
G_2	1201.2	1202.1	1160.5	1194.7	1180.1	1203.6
$TR_{12}-TR_{21}$	0	0	0	0	0	----
$U(x_1^A,G_1)$	4.2159	4.0196	4.2145	4.2155	4.2149	4.2160
$U(x_2^A,G_2)$	4.2159	4.0196	4.2145	4.2155	4.2149	4.2160
$U(x_1^B,G_1)$	3.8161	4.0196	3.8771	3.8274	3.8508	3.8128
$U(x_2^B,G_2)$	3.9376	4.0196	3.8771	3.9268	3.9039	3.9407
ϕ_1^A		-0.027				
ϕ_2^A		-0.053				
ϕ_1^B		0.04				
ϕ_2^B		0.017				
ϕ^A			+31.98			
ϕ^B			+41.19			
ϕ^R				+12.87		
ϕ^y					-39.833	
ϕ^*						3.7070

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C7:

Type A Majority in Region 1 and Type B Majority in Region 2/ Voluntary Transfers Permitted/ Not Permitted Computed Equilibrium

$\theta_k = 1.01$, $L^A = 5000$, $L_1^B = 1000$ $L_2^B = 4000$

	NC	C1	C2	C3	C4	C5
L_1^A	2518.0	4000	4000	1171.2	2524.9	1677.5
L_2^A	2482.0	1000	1000	3828.8	2475.1	3322.5
y_1	3694.9	4285.1	4285.1	2974.2	3698.0	3278.3
y_2	5056.4	4242.6	4242.7	5595.7	5033.3	5406.2
G_1	857.7	1066.0	1068.4	590.8	859.1	692.2
G_2	1207.7	1066.0	4064.5	1530.1	1206.0	1408.2
TR_{12}-TR_{21}	------	------	-----	-----	-----	-----
$U(x_1^A, G_1)$	4.2801	4.0865	4.0770	4.2340	4.2806	4.2393
$U(x_2^A, G_2)$	4.2801	4.0865	4.0770	4.2340	4.2806	4.2393
$U(x_1^B, G_1)$	5.3935	4.0865	4.0960	4.4433	5.3970	4.8904
$U(x_2^B, G_2)$	3.8023	4.0865	4.0960	4.1921	3.7998	4.0594
ϕ_1^A		0.0672				
ϕ_2^A		-0.2786				
ϕ_1^B		-0.2899				
ϕ_2^B		0.0750				
ϕ^A			276.62			
ϕ^B			-291.9			
ϕ^R				-556.74		
ϕ^Y					-2.9405	
ϕ^*						346.68

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C8:

Type A Majority in Region 1 and Type B Majority in Region 2/ Voluntary Transfers Permitted / Not Permitted
Computed Equilibrium
$\theta_k = 0.97$, $L^A = 5000$, $L_1^B = 1000$ $L_2^B = 4000$

	NC	C1	C2	C3	C4	C5
L_1^A	2320.7	4000	4000	1051.66	2423.9	1513.5
L_2^A	2679.3	1000	1000	3948.34	2576.1	3486.5
y_1	3461.5	4115.4	4115.3	2778.6	3507.5	3059.4
y_2	5143.3	4242.6	4242.8	5638.5	5098.3	5469.1
G_1	806.47	1044.8	1037.3	558.9	826.4	650.4
G_2	1235.0	1044.8	1048.8	1538.7	1210.5	1426.7
TR_{12}-TR_{21}	-----	-----	------	------	------	-----
$U(x_1^A,G_1)$	4.2025	4.0052	3.9768	4.1794	4.2084	4.1763
$U(x_2^A,G_2)$	4.2025	4.0052	3.9768	4.1794	4.2084	4.1763
$U(x_1^B,G_1)$	5.1854	4.0052	4.0335	4.2446	5.2380	4.6842
$U(x_2^B,G_2)$	3.8050	4.0052	4.0337	4.1670	3.7699	4.0438
ϕ_1^A		0.0813				
ϕ_2^A		-0.2956				
ϕ_1^B		-0.2616				
ϕ_2^B		0.0580				
ϕ^A			301.5			
ϕ^B			-255.7			
ϕ^R				-525.8		
ϕ^y					-43.272	
ϕ^*						329.61

NC - No Constitution
C1 - Complete Income Sharing
C2 - Income Sharing By Type
C3 - Equal per Capita Rent Sharing
C4 - Maximize Output
C5 - Optimal Distribution of Population

Table C9:
Constitutional Rankings: Type A Majorities Exist in Both Regions & Voluntary Transfers Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B 2000$, $\theta_H=1.01$, $\theta_L=0.98$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.7$	1>NC>5>4>3>2
	$0.7\leq\pi<0.9$	1>NC>5>3>4>2
	$\pi=0.9$	1>NC>3>5>4>2
	$\pi=1.0$	1>3>NC>5>4>2
Type B individuals in region 1	$\pi<0.6$	3>2>4>5>NC>1
	$\pi=0.6$	3>2>NC>4>5>1
	$\pi\geq0.6$	3>NC>5>4>2>1
Type B individuals in region 2	$\pi<0.6$	NC>5>4>2>3>1
	$0.6\leq\pi<0.7$	5>NC>4>2>3>1
	$0.7\leq\pi\leq0.9$	2>5>NC>4>3>1
	$\pi=1.0$	2>5>4>NC>3>1

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.7$	1>NC>5>4>3>2
	$0.7\leq\pi<0.9$	1>NC>5>3>4>2
	$\pi=0.9$	1>NC>3>5>4>2
	$\pi=1.0$	1>3>NC>5>4>2
Type B individuals	$\pi\leq0.9$	5>NC>2>3>4>1
	$\pi=1.0$	4>5>NC>2>3>1

(c) Production and Labour Type Uncertainty

All individuals	$\pi<0.8$	1>NC>5>2>3>4
	$0.8\leq\pi\leq0.9$	1>NC>5>3>2>4
	$\pi=1.0$	1>NC>3>5>4>2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C10:
Constitutional Rankings: Type A Majorities Exist in Both Regions & Voluntary Transfers Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=2000$
$\theta_H=1.01$, $\theta_L=0.98$

(a) Production Uncertainty Only

Type A individuals	1>3>NC>5>4>2	
Type B individuals in region 1	$\pi<0.6$	2>4>5>NC>3>1
	$\pi=0.6$	2>NC>4>5>3>1
	$\pi=0.7$	NC>3>5>4>2>1
	$\pi\geq 0.8$	3>NC>5>4>2>1
Type B individuals in region 2	$\pi\leq 0.6$	3>NC>5>4>2>1
	$\pi=0.7$	2>4>5>3>NC>1
	$\pi\geq 0.8$	2>4>5>NC>3>1

(b) Production and Region of Residence Uncertainty

Type A individuals	1>3>NC>5>4>2	
Type B individuals	$\pi<1.0$	5>2>NC>3>4>1
	$\pi=1.0$	4>5>2>NC>3>1

(c) Production and Labour Type Uncertainty

All individuals	$\pi<1.0$	1>3>NC>5>4>2
	$\pi=1.0$	1>3>NC>4>5>2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C11:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted Under Constitution

$L^A = 5000, \; L_1^B = L_2^B = 3500$

$\theta_H = 1.01, \; \theta = 0.98$

(a) Production Uncertainty Only

Type A individuals	$\pi < 0.3$	5>NC>3>4>2>1
	$0.3 \leq \pi < 0.5$	5>NC>3>2>4>1
	$\pi = 0.5$	5>2>NC>3>4>1
	$\pi \geq 0.5$	2>5>NC>3>4>1
Type B individuals in region 1	$\pi < 0.7$	1>2>4>3>NC>5
	$\pi \geq 0.7$	1>5>NC>3>4>2
Type B individuals in region 2	$\pi < 0.7$	1>5>NC>3>4>2
	$\pi \geq 0.7$	1>2>NC>4>3>5

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi < 0.3$	5>NC>3>4>2>1
	$0.3 \leq \pi < 0.5$	5>NC>3>2>4>1
	$\pi = 0.3$	5>2>NC>3>4>1
	$\pi \geq 0.5$	2>5>NC>3>4>1
Type B individuals	1>4>3>2>NC>5	

(c) Production and Labour Type Uncertainty

All individuals	$\pi < 0.4$	1>NC>3>4>2
	$\pi = 0.4$	1>NC>3>2>4
	$\pi = 0.5$	1>NC>2>3>4
	$\pi \geq 0.5$	1>2>NC>3>4

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C12:
Constitutional Rankings: Type A Majority in Region 1 & Type B Majority in Region 2 & Voluntary Transfers Not Permitted Under Constitution
$L^A=5000$, $L_1^B=1000$, $L_2^B=4000$
$\theta_H=1.01$, $\theta_L=0.98$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.7$	4>NC>3>5>1>2
	$\pi\geq0.7$	4>NC>3>5>2>1
Type B individuals in region 1	$\pi<0.7$	4>NC>5>3>2>1
	$\pi\geq0.7$	4>NC>5>3>1>2
Type B individuals in region 2	$\pi=0.1$	3>5>2>1>NC>4
	$0.2\leq\pi<0.5$	3>2>5>1>NC>4
	$0.5\leq\pi<0.7$	3>2>1>5>NC>4
	$\pi\geq0.7$	3>1>2>5>NC>4

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.7$	4>NC>3>5>1>2
	$\pi\geq0.7$	4>NC>3>5>2>1
Type B individuals	$\pi<0.3$	3>5>NC>4>2>1
	$0.3\leq\pi<0.7$	3>5>NC>4>2>1
	$\pi\geq0.7$	3>5>NC>4>1>2

(c) Production and Labour Type Uncertainty

All individuals	3>5>NC>4>2>1

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C13:
Constitutional Rankings: Type A Majorities Exist in Both Regions & Voluntary Transfers Not Permitted Under Constitution
$L^A = 5000$, $L^B_1 = L^B_2 2000$
$\theta_H = 1.03$, $\theta_L = 0.97$

(a) Production Uncertainty Only

Type A individuals	$\pi < 0.4$	1 > NC > 3 > 5 > 4 > 2
	$\pi \geq 0.4$	1 > 3 > NC > 5 > 4 > 2
Type B individuals in region 1	$\pi < 0.3$	2 > 4 > 5 > NC > 3 > 1
	$0.3 \leq \pi < 0.5$	2 > 4 > NC > 5 > 3 > 1
	$\pi = 0.5$	NC > 4 > 5 > 2 > 3 > 1
	$0.5 < \pi < 0.8$	NC > 3 > 5 > 4 > 2 > 1
	$\pi \geq 0.8$	3 > NC > 5 > 4 > 2 > 1
Type B individuals in region 2	$\pi < 0.4$	3 > NC > 5 > 4 > 2 > 1
	$\pi = 0.4$	3 > 5 > NC > 4 > 2 > 1
	$\pi = 0.5$	4 > 5 > 2 > 3 > NC > 1
	$\pi = 0.6$	2 > 4 > 5 > 3 > NC > 1
	$\pi > 0.6$	2 > 4 > 5 > NC > 3 > 1

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi < 0.4$	1 > NC > 3 > 5 > 4 > 2
	$\pi \geq 0.4$	1 > 3 > NC > 5 > 4 > 2
Type B individuals	4 > 5 > 2 > NC > 3 > 1	

(c) Production and Labour Type Uncertainty

All individuals	$\pi < 0.8$	1 > NC > 5 > 3 > 4 > 2
	$0.8 \leq \pi \leq 0.9$	1 > NC > 3 > 5 > 4 > 2
	$\pi = 1.0$	1 > 3 > NC > 5 > 4 > 2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C14:
Constitutional Rankings: Type A Majorities Exist in Both Regions
& Voluntary Transfers Permitted Under Constitution
$L^A=5000$, $L^B_1=L^B_2=2000$
$\theta_H=1.03$, $\theta_L=0.97$

(a) Production Uncertainty Only

Type A individuals	1>NC>5>4>3>2	
Type B individuals in region 1	$\pi<0.4$	3>2>4>5>NC>1
	$\pi=0.4$	3>2>4>NC>5>1
	$\pi=0.5$	NC>2>4>5>3>1
	$\pi>0.5$	NC>5>4>2>3>1
Type B individuals in region 2	$\pi<0.4$	NC>5>4>2>3>1
	$\pi=0.4$	5>NC>4>2>3>1
	$\pi=0.5$	2>4>5>3>NC>1
	$\pi>0.5$	3>2>4>5>NC>1

(b) Production and Region of Residence Uncertainty

Type A individuals	1>NC>5>4>3>2
Type B individuals	2>4>5>NC>3>1

(c) Production and Labour Type Uncertainty

All individuals	1>NC>5>4>2>3

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C15:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution

$L^A=5000$, $L_1^B=L_2^B=3500$

$\theta_H=1.03$, $\theta_L=0.97$

(a) Production Uncertainty Only

Type A individuals		5>NC>3>4>2>1
Type B individuals in region 1	$\pi<0.5$	1>2>4>3>NC>5
	$\pi=0.5$	1>4>3>2>NC>5
	$\pi>0.5$	1>5>NC>3>4>2
Type B individuals in region 2	$\pi<0.5$	1>5>NC>3>4>2
	$\pi=0.5$	1>4>3>2>NC>5
	$\pi>0.5$	1>2>4>3>NC>5

(b) Production and Region of Residence Uncertainty

Type A individuals	5> NC>3>4>2>1
Type B individuals	1>4>3>2>NC>5

(c) Production and Labour Type Uncertainty

All individuals	1>5>NC>3>4>2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C16:
Constitutional Rankings: Type A Majority in Region 1 & Type B Majority in Region 2 & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=1000$, $L_2^B=4000$, $\theta_H=1.03$, $\theta_L=0.97$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.3$	4>NC>3>5>1>2
	$0.3<\pi\leq0.6$	4>NC>5>3>2>1
	$\pi>0.6$	NC>4>5>3>2>1
Type B individuals in region 1	$\pi<0.8$	4>NC>5>3>2>1
	$\pi\geq0.8$	NC>4>3>2>1
Type B individuals in region 2	$\pi<0.4$	3>2>5>1>NC>4
	$0.4\leq\pi<0.7$	3>2>1>5>NC>4
	$\pi=0.7$	2>3>1>5>NC>4
	$\pi>0.7$	2>3>1>5>4>NC

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.3$	4>NC>3>5>1>2
	$0.3<\pi\leq0.6$	4>NC>5>3>2>1
	$\pi>0.6$	NC>4>5>3>2>1
Type B individuals	$\pi=0.1$	3>5>NC>4>2>1
	$\pi=0.2$	3>5>NC>2>4>1
	$0.2<\pi<0.7$	3>5>2>NC>4>1
	$0.7\leq\pi<1.0$	3>5>2>4>NC>1
	$\pi=1.0$	3>2>5>4>NC>1

(c) Production and Labour Type Uncertainty

All individuals	$\pi\leq0.7$	3>5>NC>4>2>1
	$0.8\leq\pi\leq0.9$	3>5>4>NC>2>1
	$\pi=1.0$	3>5>2>4>NC>1

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C17:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=3500$, $T^1=5000$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.3$	2>3>4>NC>5>1
	$\pi=0.3$	2>3>NC>5>4>1
	$0.4\leq\pi<0.7$	2>NC>5>3>4>1
	$0.7\leq\pi\leq0.9$	NC>5>2>3>4>1
	$\pi=1.0$	NC>5>2>4>3>1
Type B individuals in region 1	$\pi<0.7$	NC>5>4>3>1>2
	$\pi\geq0.7$	NC>5>3>4>1>2
Type B individuals in region 2	$\pi<1.0$	1>2>3>4>5>NC
	$\pi=1.0$	1>2>3~4>5>NC

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.3$	2>3>4>NC>5>1
	$\pi=0.3$	2>3>NC>5>4>1
	$0.4\leq\pi<0.7$	2>NC>5>3>4>1
	$0.7\leq\pi\leq0.9$	NC>5>2>3>4>1
	$\pi=1.0$	NC>5>2>4>3>1
Type B individuals	$\pi=0.1$	1>2>5>3>4>NC
	$0.1<\pi<0.3$	1>2>3>5>4>NC
	$0.3\leq\pi<0.7$	1>2>3>5>NC>4
	$\pi\geq0.7$	1>3>2>5>NC>4

(c) Production and Labour Type Uncertainty

All individuals	$\pi=0.1$	1>2>3>4>5>NC
	$0.1<\pi<0.3$	1>2>3>5>4>NC
	$\pi\geq0.3$	1>2>3>5>NC>4

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5: Optimal Population Distribution

Table C18:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=3500$, $T^1=4500$

(a) Production Uncertainty Only

Type A individuals	$\pi=0.1$	3>4>2>5>NC>1
	$\pi=0.2$	3>2>4>5>NC>1
	$0.2<\pi<0.4$	3>5>2>4>NC>1
	$\pi=0.4$	3>5>NC>2>4>1
	$\pi=0.5$	5>NC>3>2>4>1
	$\pi>0.5$	NC>5>2>3>4>1
Type B individuals in region 1	$\pi<0.5$	NC>5>1>4>3>2
	$\pi=0.5$	NC>5>4>1>3>2
	$\pi=0.6$	NC>5>4>3>1>2
	$\pi>0.6$	NC>5>3>4>1>2
Type B individuals in region 2	$\pi<0.7$	1>2>3>4>5>NC
	$\pi\geq0.7$	1>2>4>3>5>NC

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi=0.1$	3>4>2>5>NC>1
	$\pi=0,2$	3>2>4>5>NC>1
	$0.2<\pi<0.4$	3>2>5>4>NC>1
	$\pi=0.4$	3>5>NC>2>4>1
	$\pi=0.5$	5>NC>3>2>4>1
	$\pi>0.5$	NC>5>2>3>4>1
Type B individuals	$\pi=0.1$	1>2>5>4>NC>3
	$0.1<\pi<0.3$	1>2>4>5>NC>3
	$\pi=0.3$	1>2>4>5>3>NC
	$0.3<\pi<0.7$	1>4>2>3>5>NC
	$0.7\leq\pi\leq0.8$	1>4>3>2>5>NC
	$\pi>0.8$	1>3>4>2>5>NC

Table C18 cont'd:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=3500$, $T^I=4500$

(c) Production and Labour Type Uncertainty

All individuals	$\pi<0.3$	1>3>2>4>5>NC
	$\pi\geq0.3$	1>2>3>4>5>NC

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5: Optimal Population Distribution

Table C19:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=3800$, $L_2^B=3500$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.3$	NC>2>5>4>3>1
	$0.3\leq\pi<0.5$	NC>5>2>4>3>1
	$0.5\leq\pi<0.8$	NC>5>2>4>3>1
	$\pi=0.8$	NC>5>4>3>2>1
	$\pi=0.9$	NC>3>5>4>2>1
	$\pi=1.0$	3>4>5>NC>2>1
Type B individuals in region 1	$\pi<0.4$	1>2>3>4>5>NC
	$0.4\leq\pi<0.8$	1>2>3>5>4>NC
	$0.8\leq\pi<1.0$	1>3>2>5>NC>4
	$\pi=1.0$	1>3>5>2>NC>4
Type B individuals in region 2	$\pi<0.4$	1>NC>5>4>3>2
	$0.4\leq\pi<0.8$	1>NC>4>5>3>2
	$\pi\geq0.8$	1>4>NC>5>2>3

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.3$	NC>2>5>4>3>1
	$0.3\leq\pi<0.5$	NC>5>2>4>3>1
	$0.5\leq\pi<0.8$	NC>5>2>4>3>1
	$\pi=0.8$	NC>5>4>3>2>1
	$\pi=0.9$	NC>3>5>4>2>1
	$\pi=1.0$	3>4>5>NC>2>1
Type B individuals	$\pi<0.6$	1>3>4>5>NC>2
	$0.6\leq\pi<0.9$	1>3>5>4>NC>2
	$\pi\geq0.9$	1>3>5>NC>4>2

Table C19 cont'd:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A = 5000$, $L_1^B = 3800$, $L_2^B = 3500$

(c) Production and Labour Type Uncertainty

All individuals	$\pi < 0.3$	1>3>4>5>NC>2
	$0.3 \leq \pi < 0.7$	1>3>5>4>NC>2
	$\pi \geq 0.7$	1>3>5>NC>4>2

NC: No Contract
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C20:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=4000$, $L_2^B=3500$

(a) Production Uncertainty Only

Type A individuals	$\pi<0.3$	NC>2>5>4>3>1
	$\pi=0.3$	NC>5>4>2>3>1
	$\pi=0.4$	NC>5>4>3>2>1
	$0.4<\pi<1.0$	NC>4>5>3>2>1
	$\pi=1.0$	3>4>NC>5>2>1
Type B individuals in region 1	$\pi<0.7$	1>2>3>5>4>NC
	$0.7\leq\pi<0.9$	1>3>2>5>4>NC
	$\pi\geq0.9$	1>3>2>5>NC>4
Type B individuals in region 2	$\pi<0.8$	1>NC>4>5>3>2
	$0.8\leq\pi<0.9$	1>NC>4>5>2>3
	$\pi\geq0.9$	1>4>NC>5>2>3

(b) Production and Region of Residence Uncertainty

Type A individuals	$\pi<0.3$	NC>2>5>4>3>1
	$\pi=0.3$	NC>5>4>2>3>1
	$\pi=0.4$	NC>5>4>3>2>1
	$0.4<\pi<1.0$	NC>4>5>3>2>1
	$\pi=1.0$	3>4>NC>5>2>1
Type B individuals	$\pi=0.1$	1>3>4>5>NC>2
	$0.1\leq\pi<.9$	1>3>5>NC>2
	$\pi\geq0.9$	1>3>5> >4>2

Table C20 cont'd:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000,\ L_1^B=4000,\ L_2^B=3500$

(c) Production and Labour Type Uncertainty

All individuals	$\pi<0.6$	1>3>5>4>NC>2
	$\pi=0.6$	3>1>5>4>NC>2
	$0.6<\pi<0.8$	3>5>1>4>NC>2
	$0.8\leq\pi<0.9$	3>5>1>NC>4>2
	$\pi\geq0.9$	3>5>NC>4>1>2

NC: No Contract
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C21:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution
$L^A=5000$, $L_1^B=L_2^B=3500$
$\rho=0.65$

(a) Production Uncertainty Only

Type A individuals		5>NC>3>4>2>1
Type B individuals in region 1	$\pi<0.8$	1>2>4>3>NC>5
	$\pi\geq 0.8$	1>5>NC>3>4>2
Type B individuals in region 2	$\pi<0.8$	1>5>NC>3>4>2
	$\pi\geq 0.8$	1>2>4>3>NC>5

(b) Production and Region of Residence Uncertainty

Type A individuals	5>NC>3>4>2>1
Type B individuals	1>4>3>2>NC>5

(c) Production and Labour Type Uncertainty

All individuals	1>5>NC>3>4>2

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution

Table C22:
Constitutional Rankings: Type B Majorities Exist in Both Regions & Voluntary Transfers Permitted/ Not Permitted Under Constitution

$L^A=5000$, $L_1^B=L_2^B=3500$

$\rho=0.60$

(a) Production Uncertainty Only

Type A individuals	5>3>NC>4>2>1	
Type B individuals in region 1	$\pi<0.8$	1>2>4>NC>3>5
	$\pi\geq0.8$	1>5>3>NC>4>2
Type B individuals in region 2	$\pi<0.3$	1>5>3>NC>4>2
	$0.3\leq\pi<0.5$	1>5>3>NC>2>4
	$\pi=0.5$	1>5>2>3>NC>4
	$0.6\leq\pi<0.8$	1>2>5>3>NC>4
	$\pi\geq0.8$	1>2>4>NC>3>5

(b) Production and Region of Residence Uncertainty

Type A individuals	5>3>NC>4>2>1
Type B individuals	1>2>4>NC>3>5

(c) Production and Labour Type Uncertainty

All individuals	$\pi=0.1$	1>2>5>3>NC>4
	$\pi>0.1$	2>1>5>3>NC>4

NC: No Constitution
1 : Complete Income Sharing
2 : Income Sharing By Type
3 : Equal Per Capita Rent Shares
4 : Maximum Output
5 : Optimal Population Distribution